TOWNSEND BROWN 1942 VEGA AIRCRAFT NOTEBOOK
TRANSCRIBED AND REORDERED - INCLUDING STRUCTURE OF SPACE

(1)

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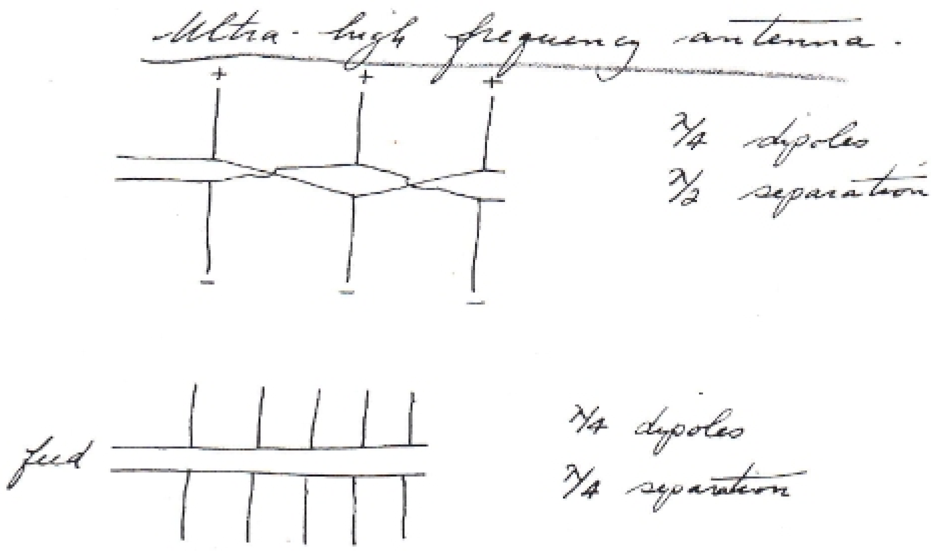
NOTES

[Transcriber's notes, 2024-07-02: This is retyped from a scanned file "TT Brown - Vega Aircraft Corp Burbank CA – Notes.pdf", SHA256 hash 38A8 51D0 3423 BA8C 881D 488A 9709 0C7B CF64 7157 9403 0ED2 E12E BBAF C1B4 A8D8, which is a low-quality scan of Townsend's handwritten notes, and the pages are in random order. An attempt has been made in this file to transcribe the sentences correctly and to arrange the pages in the correct order. The numbers in parentheses are the page numbers in the PDF, the numbers in square brackets are the internal document page number at the top right of the page, sometimes guessed if illegible. Some diagrams remain illegible. The pages of "Structure of Space", the second part of the document, are now included.]

(99) Dec 1, 1942 [1]

Ultra-high frequency antenna (multiple dipoles)

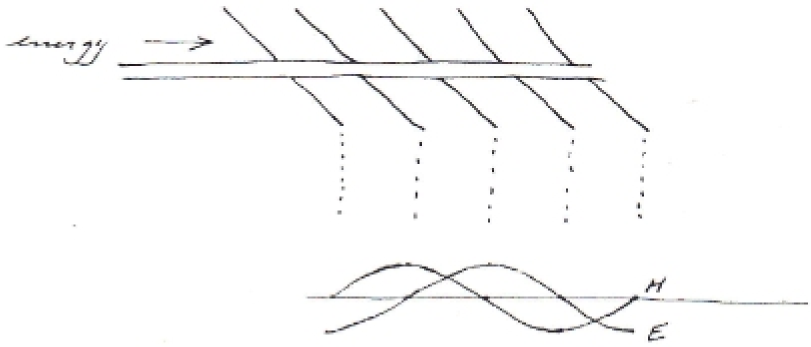


Assuming a matched transmission line with lambda/4 dipoles disposed along it:

(a) Radiation would be directed away from the feeder end.

(b) Mechanical reaction toward feeder end.

Estimate of forces and their direction.

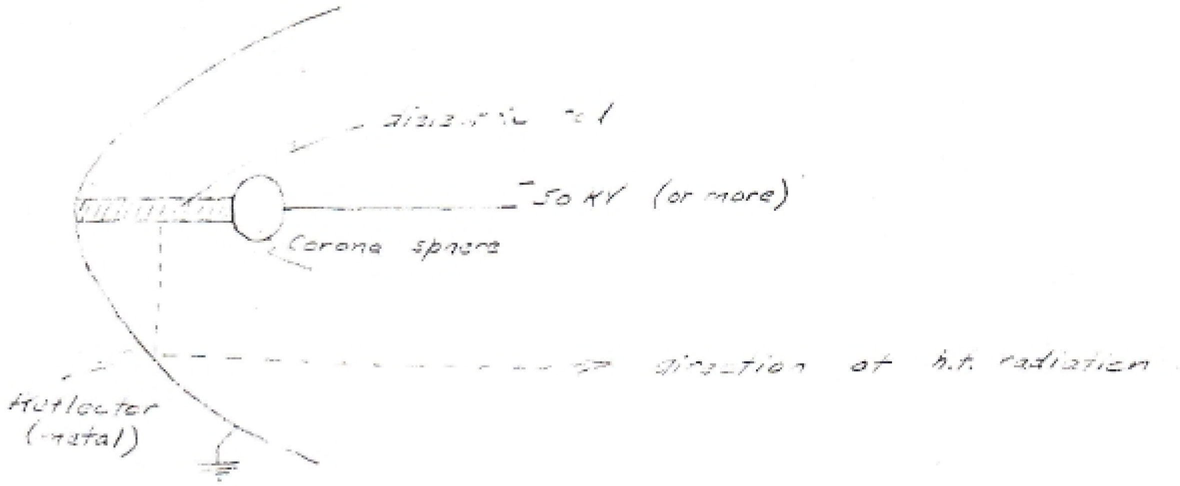


The forces developed on adjacent dipoles due to magnetic radiation of one set of dipoles is as shown on following curve.

(100) [2?]

High Frequency Radiating System

This disclosure represents an improvement on the method previously disclosed in patent "Electrostatic Motor" and sets forth an application of those principles in the service of radar.



Application of high voltage D.C. to dielectric rod
causes rod to conduct current in an [illegible]
[illegible] [illegible] to radiate electrically. [illegible]
of both [illegible] [illegible] [illegible] in this section but
rod serves as a [illegible] surface for the
[illegible] high frequency radiation. Mechanical
[illegible] [illegible] in the direction opposite radiation
[illegible] [illegible] [illegible] used for radar [illegible]

Dated this 24th of November, 1942 at
Burbank, Calif.

Witnesses as to signature and date:
[illegible]
[illegible] 11-24-42

Thomas Townsend Brown

Application of high voltage D.C. to dielectric rod causes rod to conduct current in an ?? ?? ?? to ??, electrically ... [partly illegible]

Dated this 24th of November, 1942 at ?, ?

Witnesses as to signature and date:
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[?] 11/24/42
[Thomas Townsend Brown]

(101) Dec 1, 1942 [3]

It is noted that the net force is in the direction in which the radiation is cancelled, i.e., toward the source of energy in the transmission line.

Such a force exists irrespective of the spacing of the dipoles from each other.

The force increases to a maximum, indicated by the difference in volume (area) of the curves, as the number of dipole pairs increases.

Summary

It is indicated, therefore, that an infinite number of dipoles disposed along a transmission line possessing uniformly graduated matched impedance throughout its length will radiate dielectrically toward the end of the transmission line toward which the energy is travelling *

The effect is analogous to a nozzle of a fire hose.
...
The mechanical reaction in the opposite sense is analogous to the “kick” of the hose nozzle.

* “Beverage Antenna” [Henry?] Rach’s Eng. Handbook. P. 681

(102) [4]

This consideration now resolves itself into two objectives:

(a) Production of highly directed (beamed) radiant energy

(b) The production of force or motion (reaction effect)

Both objectives will be borne in mind in the development of the method, both are equally important and useful.

Matching of transmission line

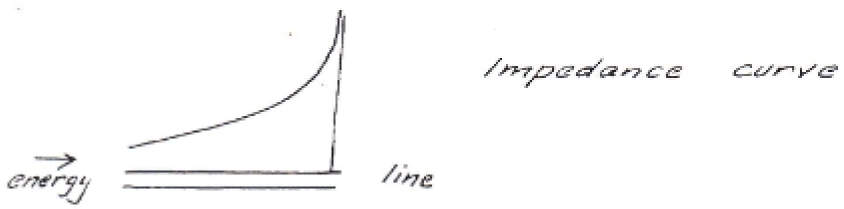
Not easy to accomplish. Some kind of gradual matching must be used. In general, the problem may be stated thus:

(a) Looking into the line (with dipoles attached) at the powered (source) end the impedance should be low and should permit maximum radiation of all dipoles.

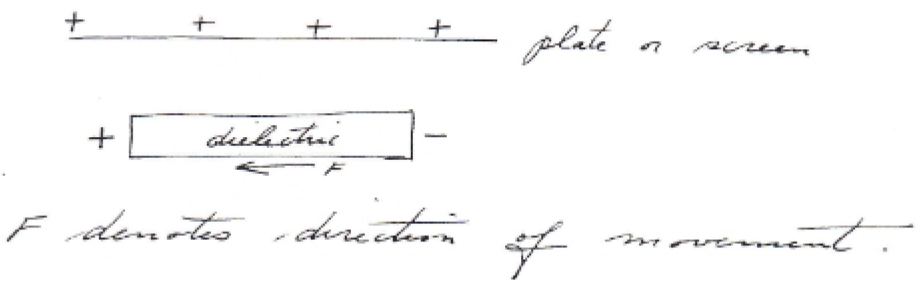
(b) Looking into the line from the other end, the impedance should be extremely high, so that no energy would be reflected back to the source end no standing waves would be formed.

(103) [5]

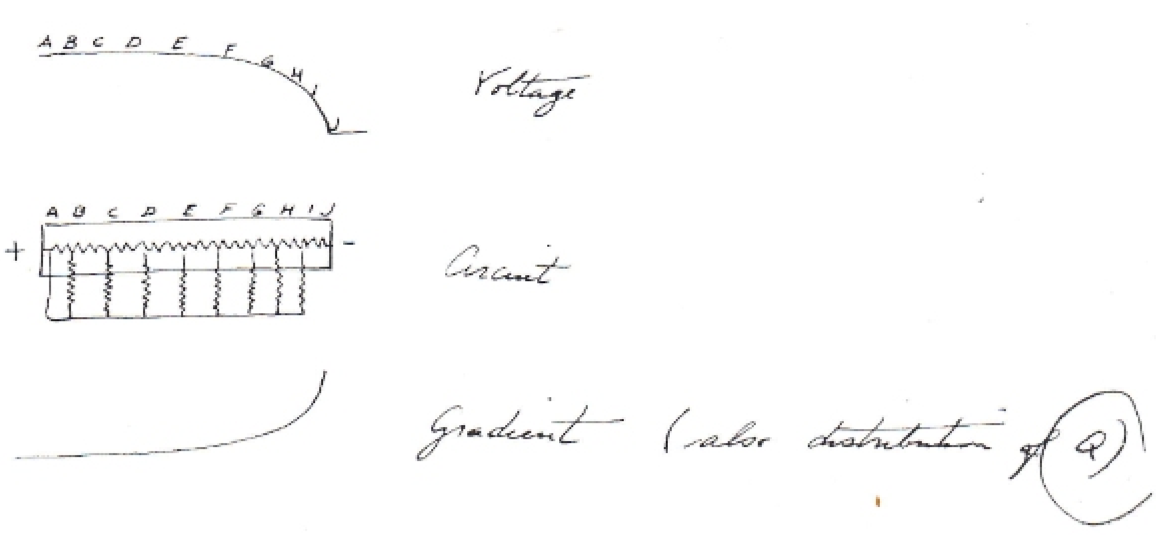
Again the situation must be analogous to a water line with the end wide open.



Turning for a moment to the behavior of a dielectric in an intense electric field the following facts have been obtained:

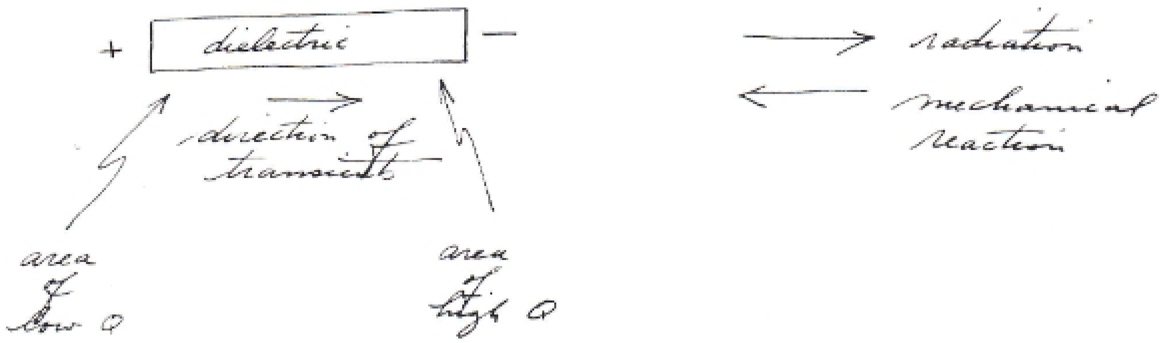


Assuming leakage along the surface of the dielectric the gradient will be as follows:

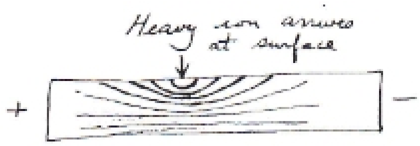


(104) [6]

If transients are produced in a dielectric it is possible that they would travel in the direction of decreasing impedance. Just what effect the gradient (electric) has on the absorption or transmission of transients remains to be seen. If the transients are absorbed it is probably because they are radiated. In that event the high gradient might increase the impedance.



Creation of high-frequency transients.



Upon arrival of a heavy ion, a "splash" is produced, and the wave travels in all directions, principally along the surface of the semi-conductor.

If penetration of the dielectric occurs, it is possible that standing waves (internal) are produced.

(105) [7]

As the “splashes” travel along, they are progressively reinforced by:

1. Attracting (by field strength) other nearby ions, then

2. By ion contact, conveying the charge away, reinforcing the current factor and the magnetic constitution of the transient.

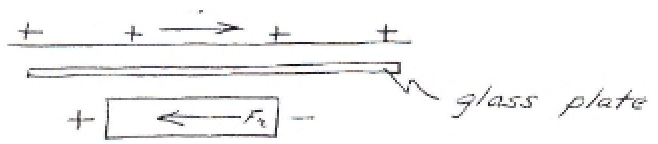
If fast ions are not available in the region the transient is not reinforced and soon attenuates.

It is indicated, therefore, that the transients are reinforced, and additional energy provided, in travelling toward the end of the dielectric where free ions are in close proximity. In this direction also, impedance matching proper for radiation is present.

Internal reinforcement is not probable. A configuration of standing waves, dependent upon frequency of the "splashes" will result. But the standing waves will progress down the length of the dielectric (phase velocity), and will be reinforced or attenuated depending on the direction they are going.

(106) [8]

In the original disclosures of the dielectric effect described on P. 6, it was the electric field, transverse to the line of dielectric gradient, which was thought to be responsible for the movement. There is experimental evidence, however, to the effect that a transfer of charges is essential, tho the magnitude of the force does not appear to be any observable relation to the ion or electron intensity.

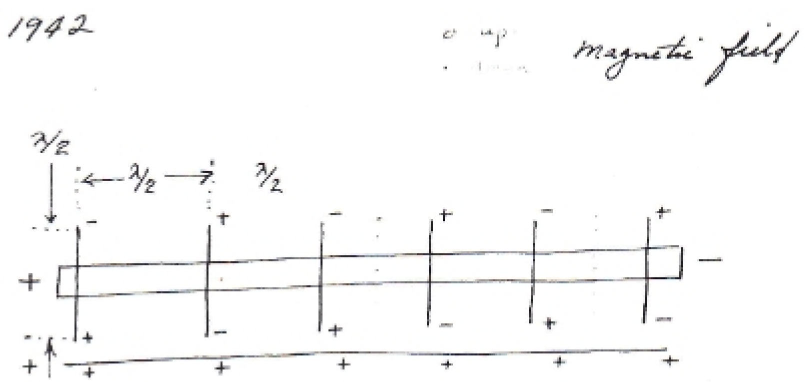


F_2 is the force exerted by the dielectric.
F_1 indicates the direction of the reaction.

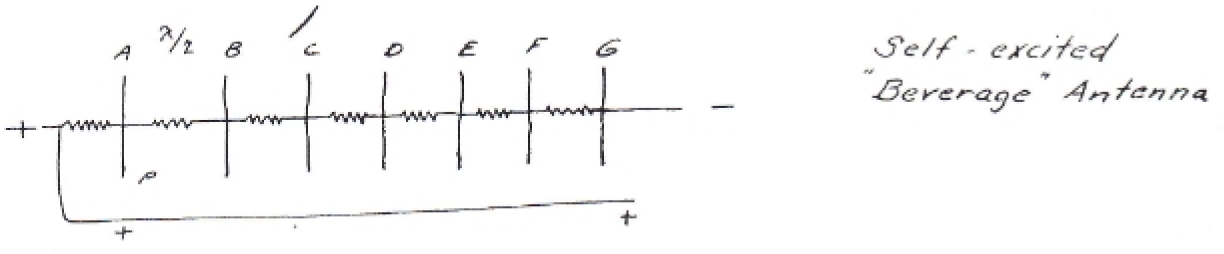
If a glass plate is placed between the two elements, the force on the reactor plate F1 disappears. No information is available on the force of the glass plate under these circumstances, or the effect on F2.

In the absence of information to the contrary, it is considered reasonable to assume ionic or electronic conduction, and to develop the "splash" theory of transients.

(107) Dec 4, 1942 [9]



To begin with, let us assume a simple resonant system where a "semi-conducting rod" is used as a voltage divider and lambda/2 rods are disposed along it, spaced lambda/2 apart. The circuit would be as follows:



A flow of electrons (or ions) occurs from the point P to the positive plate. This causes a current flow thru one "arm" of the dipole-current system, and a difference of potential results. For, at this point on, the voltage divider the voltage is just enough to start ionization at point P.

Successive points produce waves of electrons, regions of maxima and minima.

(108) [10]

The expanding electro-magnetic radiation induces an opposite EMF in the adjacent dipole. This "field" to the plate starts a flow of electrons (or ions) which gets underway 90 degrees later and reaches maximum as the EMF reaches zero.

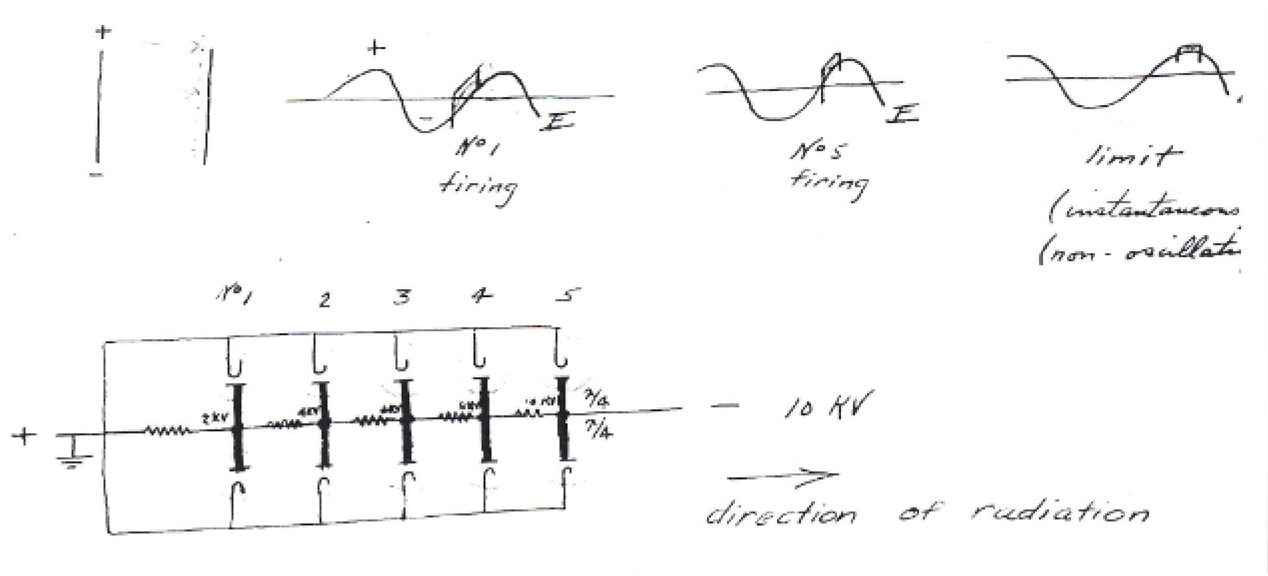
The reinforced electromagnetic radiation then "fires" succeeding dipoles in the same way, gaining energy from the currents successively employed.

The wave front travels along, gaining energy from each dipole in rapid succession.

Why, as in the case of transients previously discussed, the direction of wave travel is fixed, is not well understood. It may depend on the impedance of the system, the electric gradient or the transient time of the firing electrons or ions. In any event, it is fixed and is in the direction of the higher gradient.

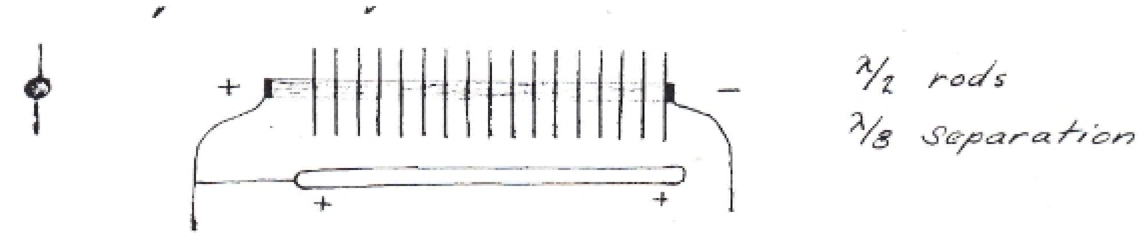
If transient time is the cause, the following hypothesis may serve to explain the results for the time being.

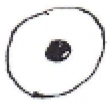
(109) [11?]



As a control oscillator, No. 1 is most effective. Its energy of oscillation is greatest. As the potential increases the oscillator becomes less a "leader" and more a "follower". But the wave gains energy uniformly, due to the increasing amplitude.

Modifications for practical use





or in the form of discs with the same spacing.

(110) Dec 7, 1942 [12]

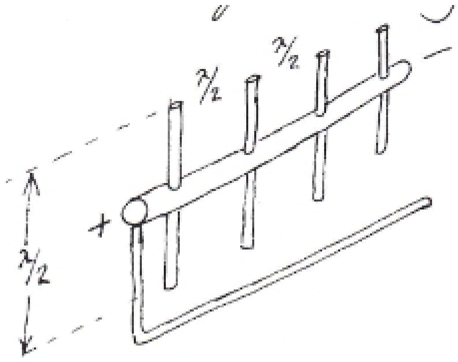
Series Condenser

Increasing the number of plates should increase both the directivity and intensity of radiation and the reaction forces in accordance with integrated curve as shown on P. 2.

Block of Dielectric

It appears to make little fundamental difference if the series condenser were substituted by a solid block of dielectric material.

For preliminary tests of the principle -



lambda/2 rods disposed along a dielectric (low resistivity)

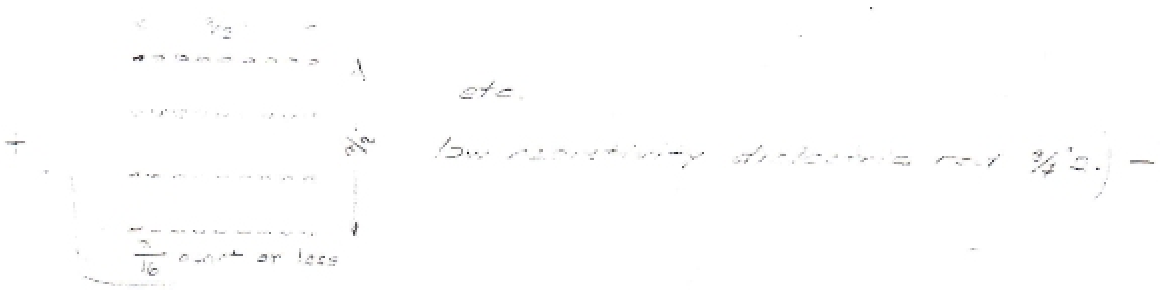
rod lambda/2 distance apart

With ionizing wire (or plate) attached to one end of rod. A relatively high DC potential is applied so that a gradient is present along the dielectric rod.

For a plate, a larger tube to both sides of the dipoles may be used. Dipoles may be about 2 inches long (2 inches apart) to generate 10 cm waves.

(111) Dec 7, 1942 [T T Brown] [13?]

As an alternate to this design, for test purposes, a large number of 2" (lambda/2) dipoles may be disposed at very close spacing along the dielectric rod.



This modification may offer greater radiation directivity and sensitivity - also greater reaction forces.

In such a device, dipoles are set into oscillation at resonant frequency by the periodic escape of ions or electrons from the ends of the dipoles. Succeeding dipoles pick up the oscillation by induction, reinforce it and pass it on. The result is a train of waves running longitudinally and escaping from the end of the dielectric rod where the potential is greatest. The mechanical reaction is in the opposite direction

(112) [14]

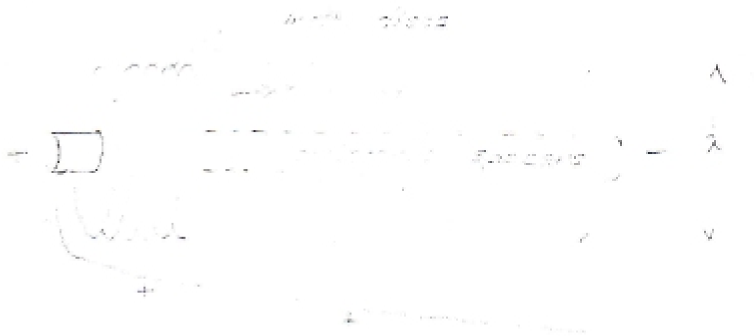
To increase capacitance between successive dipoles, several ideas may be set forth.

(1) Use a material of higher dielectric constant (specific inductive capacity) for the rod.

(2) Increase the lateral dimensions of the rod.

(3) Place condenser plates at the centers of the dipoles.

(4) Use circular plates as dipoles (one pole at center and others in the periphery) as:



It appears that such a design would be most effective if the diameter of the plates would be one wavelength. (For 10 cm - 4 inches)

Equivalent circuit

(113) [15?]

External excitation

In all of the types previously described the excitation has been "external".

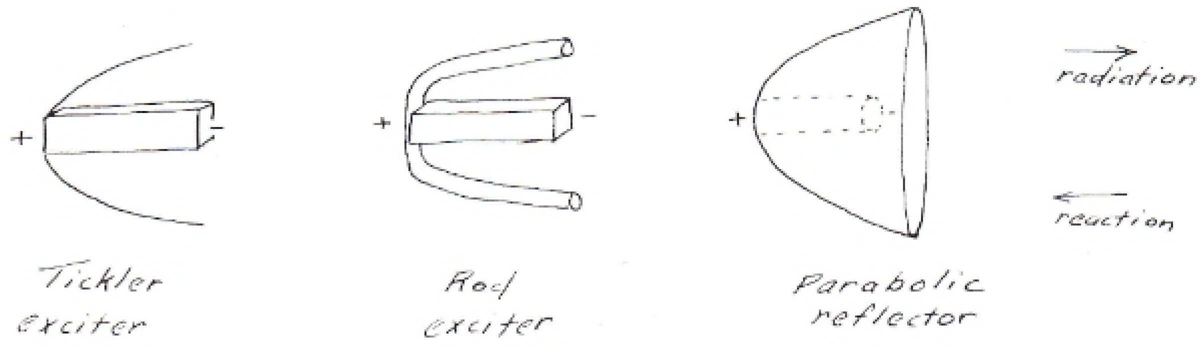
The movement of electrons and/or ions causing the oscillation of the dipole has been outside of the system of dipoles.

This is accomplished in any one of several ways:

1. By the use of a "tickler" creating ions.

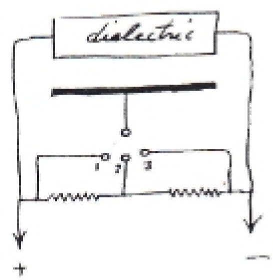
2. By a rod or conducting bar, where the steepest gradient is at the dipole end, or

3. By a flat plate, screen, cone or parabolic reflector.



The excitation determines the direction of radiation and mechanical reaction, due, presumably, to the direction of the train of waves caused by interacting dipoles.

(113) Dec 7, 1942 [T T Brown] [16?]



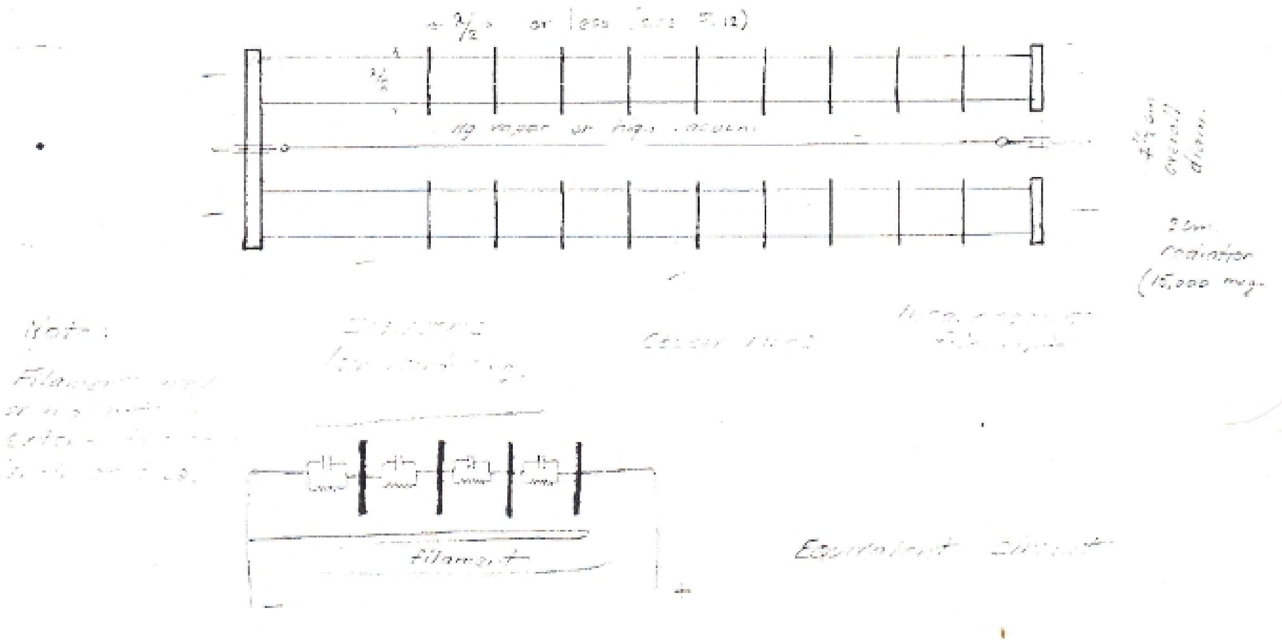
To illustrate the action of excitation, the following experimental facts are presented:

When switch is in position 1, the dielectric moves to the left. When switch is in position 3, the motion is toward the right. When in position 2, no motion is observed. The extent of this movement varies with the time of day, i.e., according to solar, sidereal and lunar curves, seasonal variations and yearly shifts.

Sudden "storms" of rapid and erratic variation are also observed.

Internal excitation

As a practical improvement, the following suggestions are offered:



(115) Dec 7, 1942 [17?]

It may be found desirable to use a confined (beamed) cathode at the negative end of the internal excited radiator. The electrons at the negative end would, therefore, be slow and would not start (or continue) oscillations in those dipoles near the negative end.

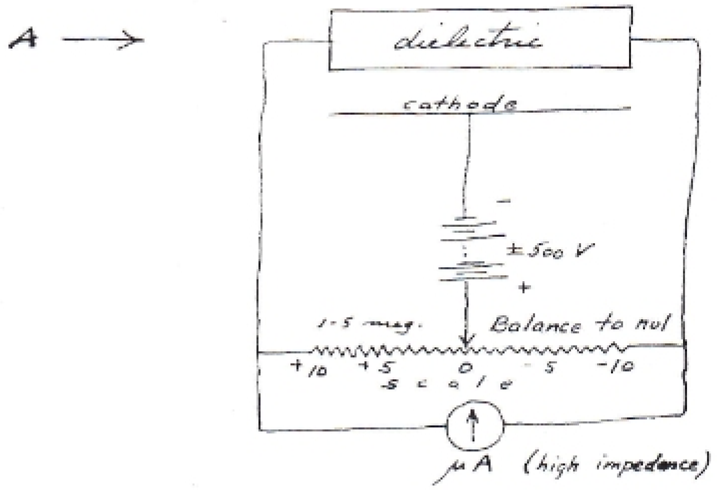
At some point along the line, where the field is of proper strength, oscillations would start. Magnetic saturation at any instant would be such as to reinforce electrostatic conditions in much the same fashion as it maintains oscillation in a magnetron. In effect, then, "transit time" would have to reach a certain value to start oscillation. Waves would travel from the end with high transit time to the end with low transit time. Electrons would be continuously accelerated the length of the tube. They would form in bunches and then energy of acceleration would be largely removed in passing regularly thru zones or resonant "chambers".

If the dipoles are of proper dimensions (1 cm) 2 cm radiation (15,000 megacycles) might be generated which would leave the device at the high voltage end. Similarly, if 2 cm radiation were received from that direction, a high voltage charge would be created at the same end.

(116) Dec 8, 1942 [T T Brown] [18?]

Thus, it appears that the “system” can be used not only to transmit electromagnetic radiation but also to receive it. It is logical that the action should be reversible.

It is interesting to note that the direction and relative intensity of received radiation is revealed by the polarity and the potential gradient of the dielectric system.

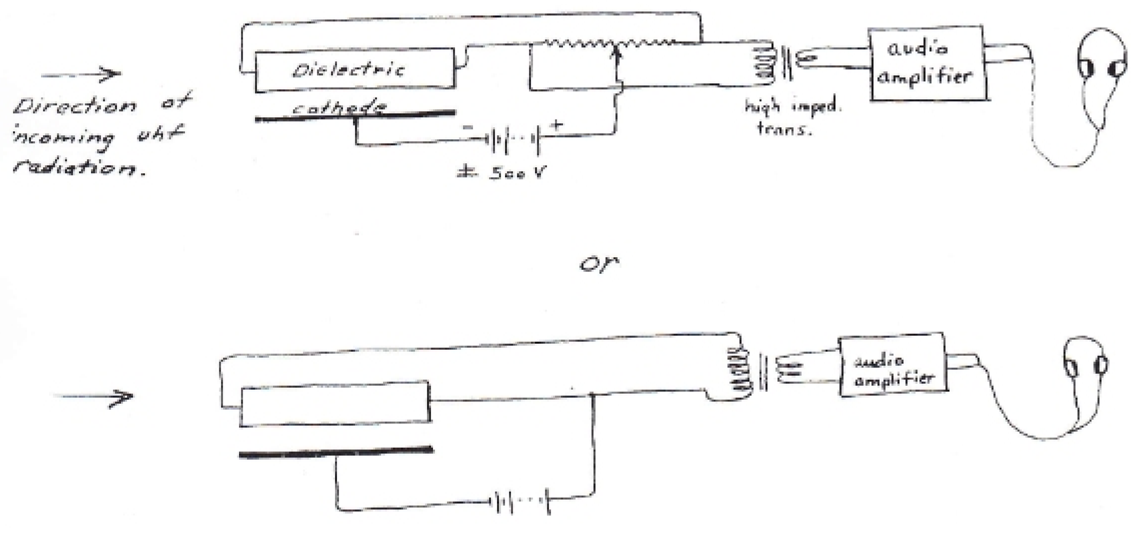


This can be done by the bridge method as indicated above.

Radiation from direction of A will cause the nul to move along the scale toward +10. While radiation from direction B will cause the nul to move toward -10. The intensity of the radiation will determine the extent of the nul shift. Modulated radiation will cause pulsating direct current at the mu A meter.

(117) Dec 8, 1942 [T T Brown] [19?]

If it is desirable to use the system to to receive modulated signals, the microammeter can be replaced by a suitable high impedance transformer and a standard amplifying circuit with headphones or loudspeaker.

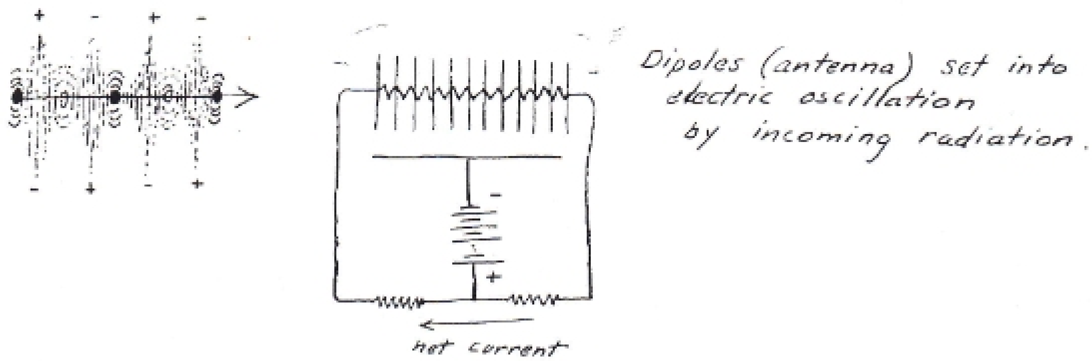


It may be seen that the "antenna" and detector are combined, just as, in the case of the transmitter, the "antenna" and oscillator are combined.

Received radiation will cause the dielectric to become differently charged with gradient in the line of direction of the source of radiation, negative charged and to "point" toward the source of received energy. This, of course, is based on the use of a “negative tickler” or cathode as in the above circuit.

(118) Dec 8, 1942 [T T Brown] [20?]

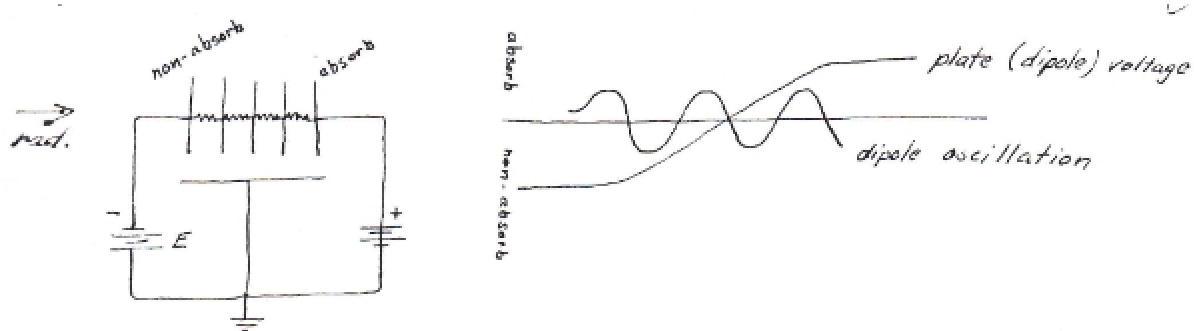
The theory of this action may be described briefly as follows:



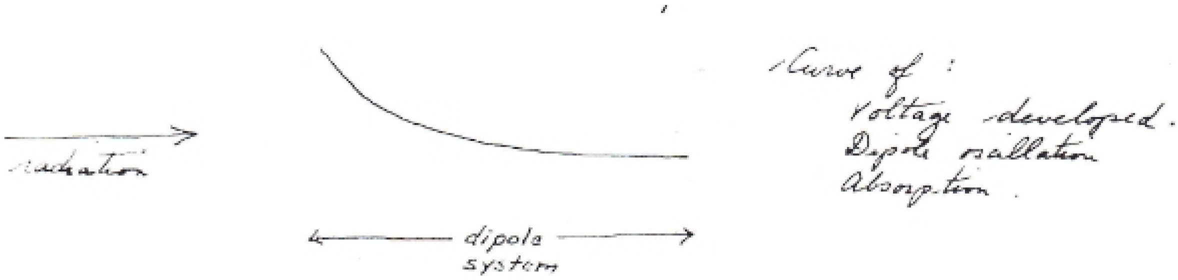
Oscillating dipoles gradually lose energy in passing along the line, i.e., energy is removed by the detecting system. The dipole nearest the high energy end is, therefore, oscillating with the greatest amplitude (voltage). Electrons are pulled from the cathode on the positive swing of the end of the dipole nearest the cathode. In succession each dipole down the line does the same thing with less and less amplitude. Finally, a limit could, theoretically, be reached where no radiant energy were present (due to absorption) and no oscillations are present. The net result, then, is a difference of potential along the system of dipoles, with the accumulated negative charges "stored" at the end of the system nearest the source of radiation. "Storage" (capacity) would depend upon the amplitude of the radiation and the absorption or loss of amplitude. The potential difference at the ends of the system would then actually be an indication

(119) [21?]

of the absorption of energy. Theoretically, the gradient would increase until a limit is reached where no absorption takes place. In other words, if the "incoming" end of the dipole system is under excitation by radiation and the dipoles are oscillating at a certain voltage amplitude, if at the same time that end of the system carries a highly negative charge so that no electrons are pulled from the cathode, then no absorption takes place.



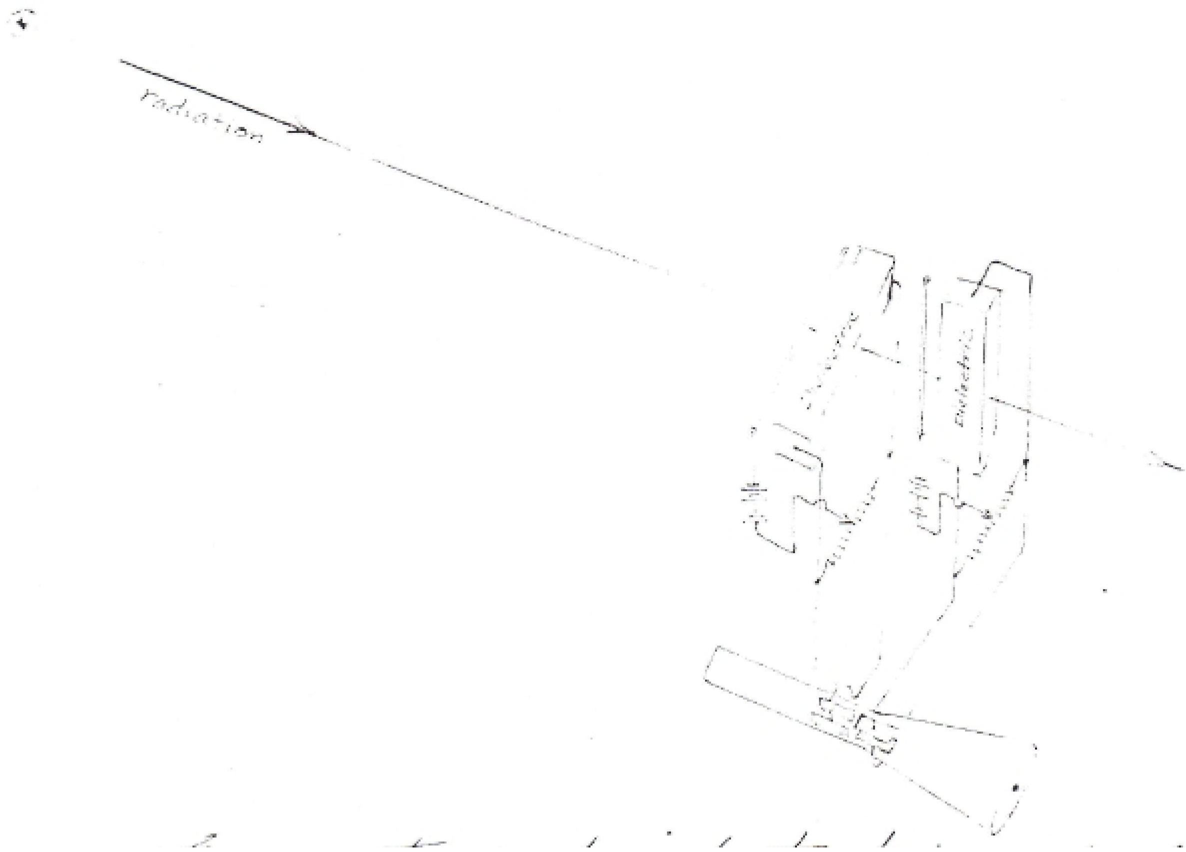
Since absorption is usually present in the receiving dielectric, the potential gradient is present. The highest negative potential lying in the direction of the highest amplitude of oscillation of the dipoles, and necessarily toward the source of radiation.



It follows that, for a unit length of dielectric, the absorption depends on the number of dipoles and the voltage.

(120) Dec 8, 1942 [22]

To determine accurately the point of origin of UHF radiation (sidereal) the following circuit, employing a cathode ray tube, is suggested:



The apparatus is designed to [train?] and elevate and the spot on the cathode ray screen indicates the source as if it were viewed optically.

Witnessed this 8th of December, 1942
B.F. Jenkins 12-8-42
Carlo Re 12-8-42
T.T. Brown

Witnessed this 8th of December, 1942

[B F Jenkins 12/8/42]
[Carlo Re 12/8/42]
[T T Brown]

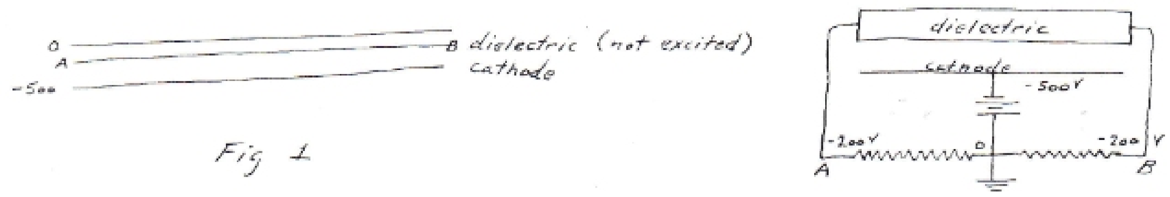
(121) Dec 8, 1942 [T T Brown] [23?]

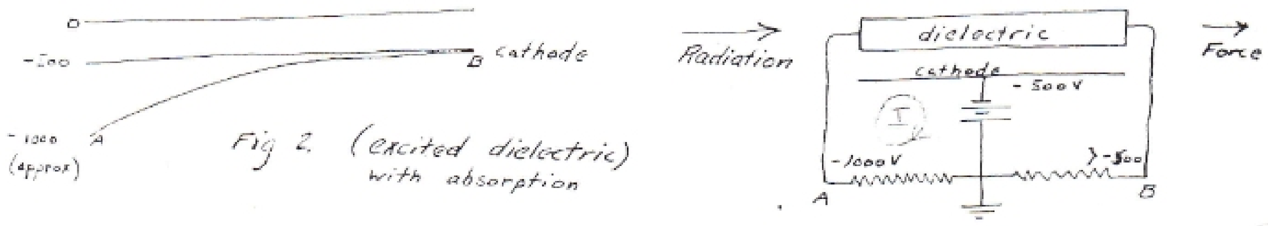
To explain the directional effect, both in emitting waves and receiving them, the amplitude of dipole oscillation appears to be the key.

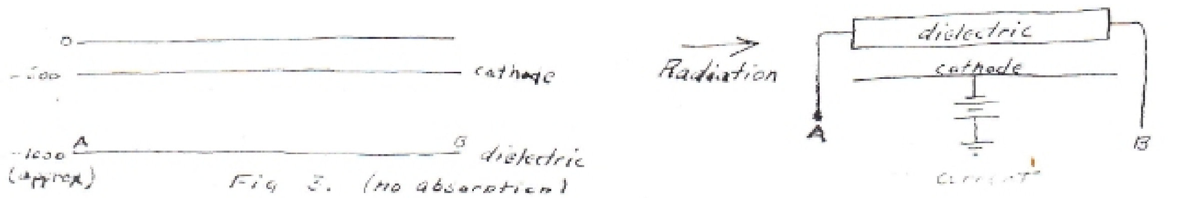
In receiving (and absorbing) UHF radiation, energy is removed from the wave. The wave causes the dipole to oscillate. If, during the oscillation, the potential reaches a value capable of pulling electrons from the cathode, an electromagnetic "drag" is introduced which not only causes a current to flow but limits the oscillation of the dipole. If the circuit is not closed and the current is capable of building up a charge, the charge will be of such a sign (polarity) as to reduce and ultimately stop the current flow. Therefore, if the neighboring body is a cathode, the dipole or system of dipoles will pull out electrons until it is "saturated", that is, it reaches such a negative potential as to not attract more electrons. This saturation value naturally depends upon the voltage amplitude of the excited dipole. A dipole near the source of radiation has a greater amplitude than one further away or where the radiation has been reduced by absorption. Its potential, therefore, is more highly negative.

(122) [24?]

A block of dielectric material, containing natural dipoles, will under such circumstances acquire an electric gradient if a current does not flow. If the neighboring body is a cathode, the gradient will slope "toward" the incoming radiation, that is, the end nearest the radiating body will become negative with respect to the other end. The potential of the entire block will become negative with respect to the cathode, so as to nullify, if it can, the last remaining "drag" of the cathode on the positive end. Thus, the electrical effect of a neighboring body is eliminated if no currents are permitted to flow. The dipoles oscillate without drag or resistance and the radiation is not absorbed.







(123) Dec 8, 1942 [25]

Fig. 1 shows the condition of the circuit where the dipoles of the dielectric are not excited. Straight conduction currents exist and the pattern is symmetrical.

Fig. 2 shows the condition when the dipoles are excited by radiation from the left side. Currents are now flowing due to the absorption of radiant energy and the loss is that indicated by I^2 R of the resistance. A voltage gradient, steepest near the end of the dielectric, exists throughout its length, and the potential approaches that of the cathode at the other end.

Fig. 3 shows the static condition with the dielectric dipoles excited but no current flowing. In this case there is no radiation resistance, no absorption, and no energy transfer. The dielectric mass acquires a static (negative) charge, the magnitude of which is determined by the energy of radiation exciting the contained dipoles.

Values of voltage shown in the curves are fictitious and are used mainly to further the explanation.

(124) [26]

It is apparent that radiation pressure will be exerted in the system shown in Fig. 2. As the electrical resistance increases, the pressure decreases until, as in Fig. 3, no radiation pressure is present.

Conversely, radiation pressure increases as electrical resistance decreases, up to the point where the voltage difference begins to drop.

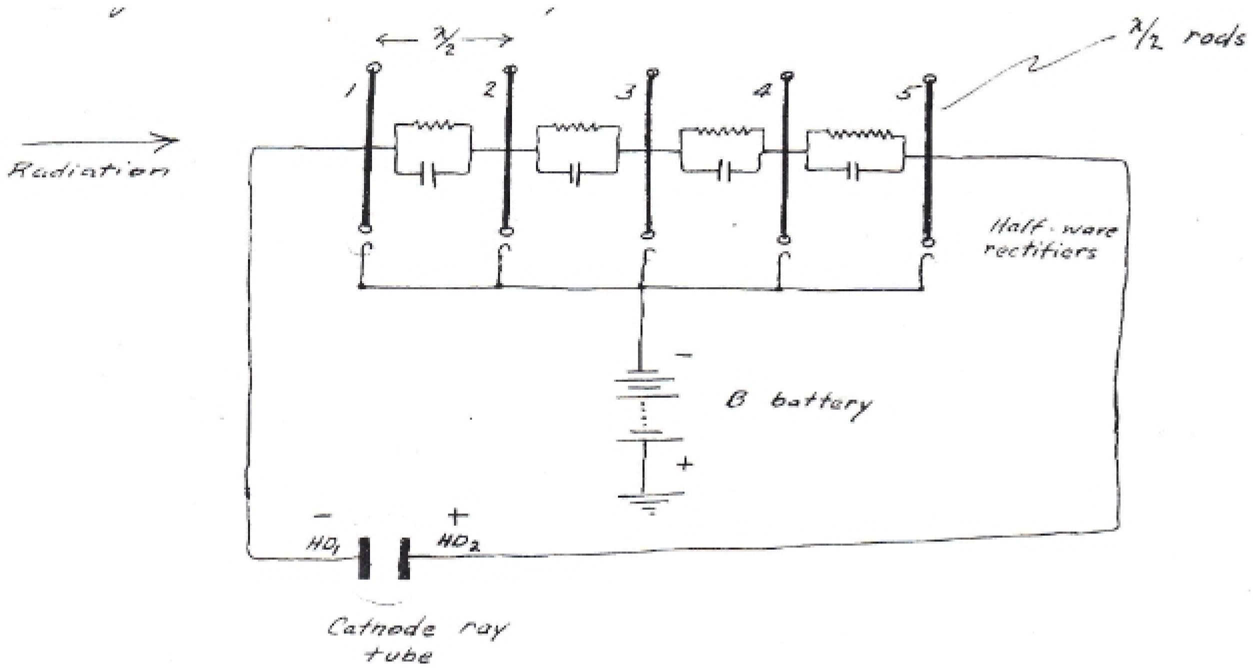
Radiation pressure is proportional to the I^2 R loss. That is, the condition which makes the current maximum is likewise that which causes the maximum radiation pressure on the dielectric system.

In the foregoing explanation, the "neighboring" body was the cathode. The same explanation holds if the neighboring body is the anode, except that all electrical signs and current directions are reversed. The radiation pressure is, however, in the same direction.

Therefore, it makes little difference, except perhaps for electron emission, convenience of construction, etc, whether the neighboring body is positive or negative with respect to the dielectric system.

(125) Dec 9, 1942 [27]

In order to understand fully the action of the receiver just described, the following simplification is set forth:

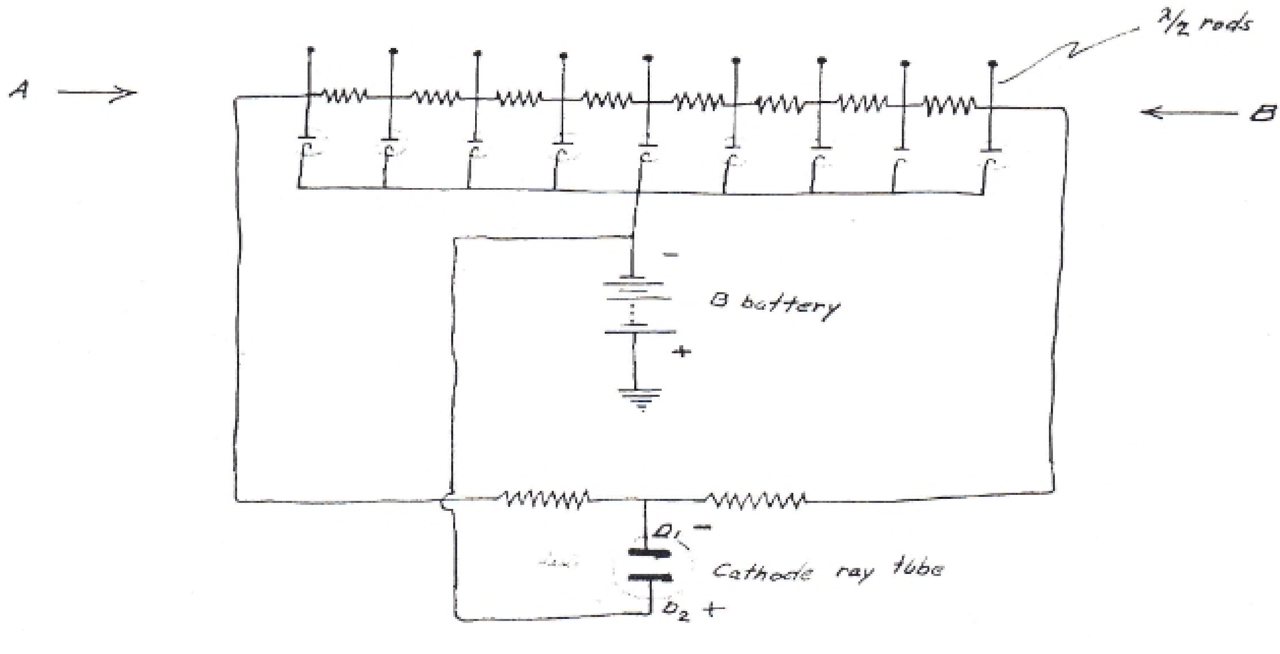


Under the influence of radiation from the left, No. 1 dipole oscillates with greatest amplitude, No 5 with the least, and since the charge (net) of the dipole depends upon the amplitude of voltage oscillation, the No. 1 dipole becomes more negative than No. 5. Hence, the "spot" on the CR tube screen moves to the right (toward the positive deflection plate).

It appears to make little change in the theoretical interpretation if the spacing of the dipoles is less than less than lambda/2, except to increase the effect.

(126) ? [T T Brown] [28?]

If directional information is not desired, the net charge of the system of dipoles may be detected. Thus, the device becomes more sensitive, but bi-lateral.



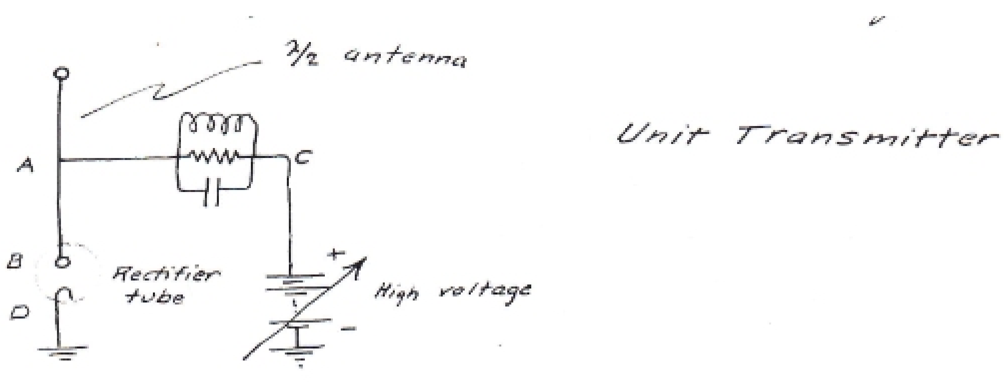
Radiation is detected with maxima either from direction A or B.

As a bilateral transmitter:

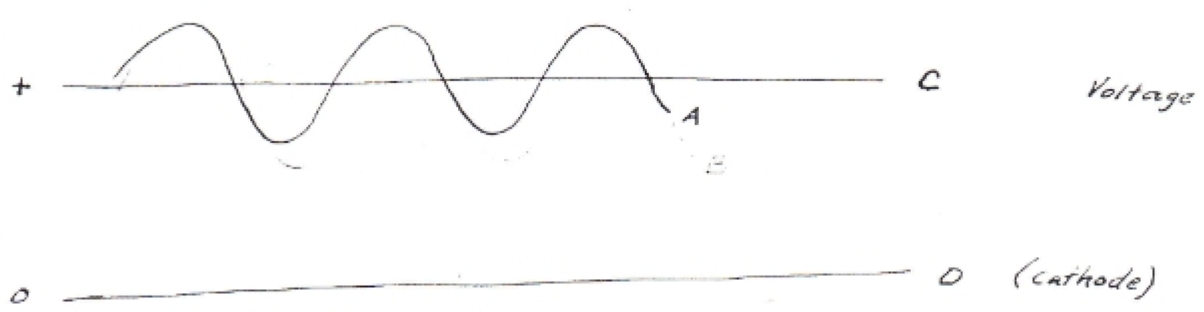
Similarly, if a strong field exists between the dipole system and the "neighboring" body such that electrons cross the space in the proper timing (transit time), oscillations are induced in all the dipoles and bilateral radiation results. No reactive forces are present in the system as a whole, due to cancellation.

(127) Dec 9, 1942 [T T Brown] [29]

Examining in detail the action of such a transmitter, the following ideas are set forth:

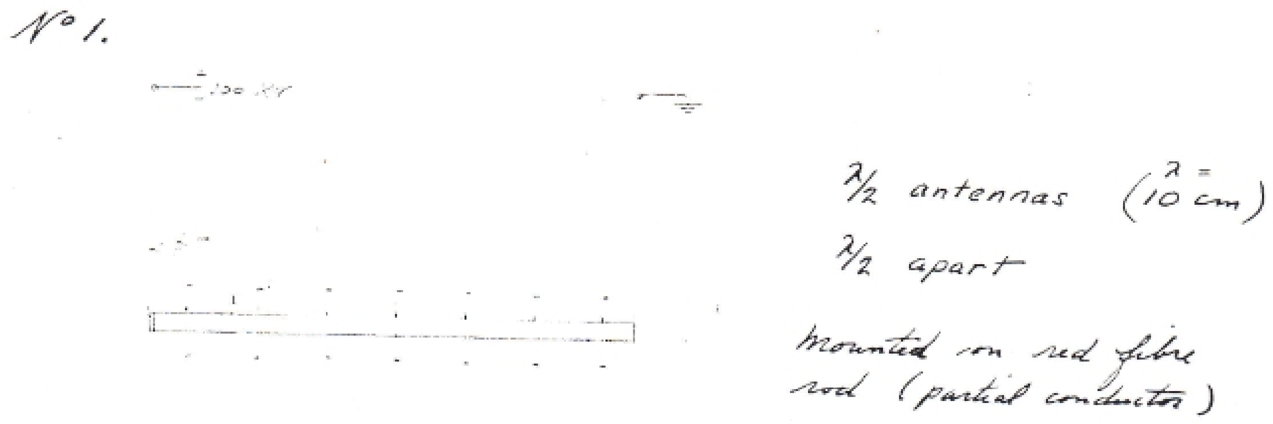


Under proper circuit conditions, oscillation of the radiating antenna will start spontaneously. Once in oscillation, the amplitude is reinforced and energy is applied in pulse form.



(128) Dec 9, 1942   Tests Proposed [30]

No. 1



To observe the angle of rise against gravity.
To derive a voltage-force curve (approx.)
To observe difference, if any, where energized by + or - and AC.

No. 2

Same as above but with lambda/2 antennas lambda/16 apart. Corrected for increased weight and conductivity of rod.

No. 3

Same type of experiment using cylindrical dielectric rods same diameter of various substances, without antennas.

No. 4. Same as No. 3 with ticklers of various lengths and shape.

(129) Dec 9, 1942 [31]

No. 5

Comparison of dielectric rods and tubes 10 cm diameter. Various materials.

No. 6

Comparison of dielectric tubes, with and without internal excitation.

No. 7

Action of a solid dielectric rod with "fine wire" internal excitation. Various diameters from 2 cm to 10 cm.

No. 8

Perfect construction technique of hot cathode in evacuated dielectric tube. Internal excitation. Effect of cathode at one end, with electrons beamed.

No. 9

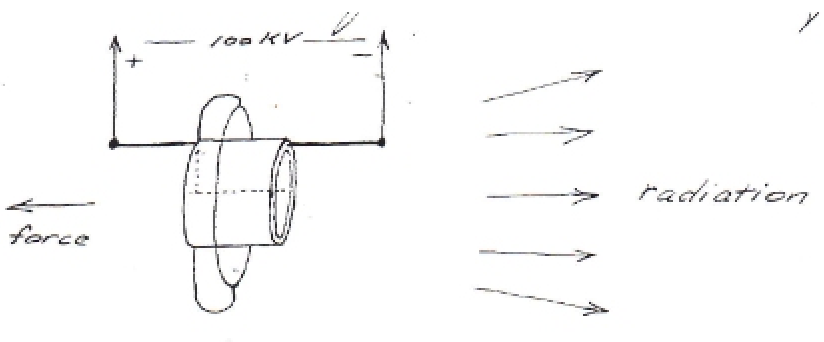
Attempt to receive 10 cm. radiation from any of the above transmitters by a standard UHF receiver (radar).

No. 10.

Attempt to receive radiation by another dielectric system, as on page 22. Observe, if possible, natural radiation from space (sidereal radiation) and its direction of approach.

(130) Dec 10, 1942 [T T Brown] [32]

Special test for demonstration of forces.



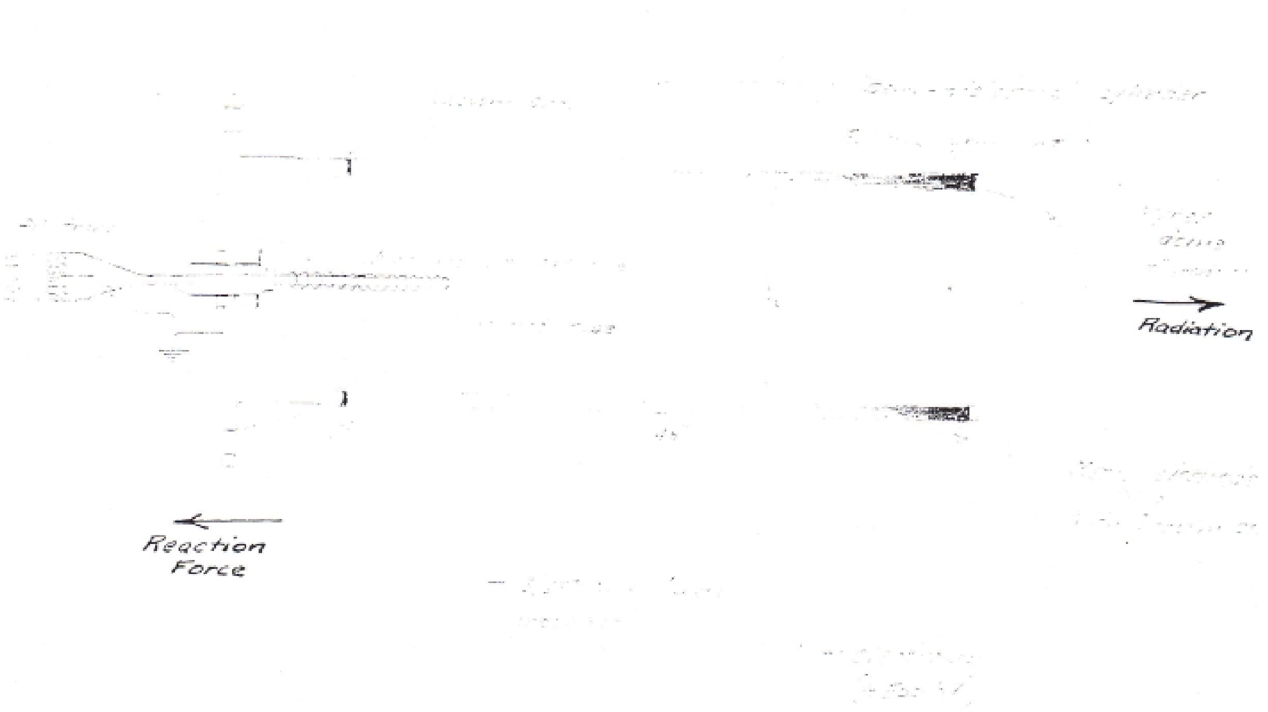
As a suggestion, to demonstrate the direction and magnitude of forces, the set-up as illustrated above will serve.

It consists essentially of a wood cylinder, made up of segments cemented together with cellulose nitrate cement, with grain running longitudinally. Cellulose nitrate windows close both ends of the cylinder, cemented to the metal foil electrodes. These windows support the fine iron ionizing wire through the center of the cylinder. Wire hooks support a similar wire circle about the outside of the cylinder. Both ionizing wires are connected electrically to one end of the cylinder. The system is suspended free to move. Upon application of approx. 100 KV (preferably with the positive end to the ionizer) the system will move as indicated.

(13) Dec 10, 1942 [33]

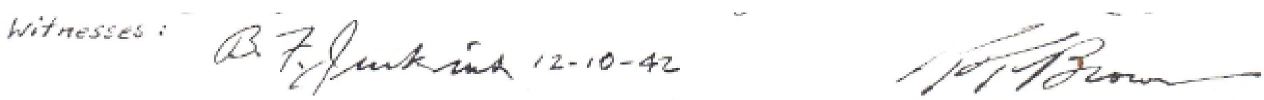
High-Powered Radiator

Progressing, for a moment, to a theoretical radiator of the future, certain special features of design are indicated:



The heat resisting “semi-dielectric” cylinder will run “hot”. Its conductivity under such conditions should be capable of being “doubled” by the cathode-to-plate current. Total current at 500 KV should be approx. 100 m.a., with full power maximum at about 1000 m.a. Dielectric must withstand exceedingly high voltage gradient near the positive electrode.

Witnesses: [B F Jenkins] 12-10-42 [T T Brown]



(10) Dec 10 [34?]

It is noticed that, in the apparatus described on P. 33, heating of the anode results from continuous operation. After the unit has become “warmed up”, it will therefore operate on AC, since the direction of the applied potential makes very little, if any difference in the resultant forces. In this case, the filament heating may be discontinued without loss of efficiency.
...
Table of wavelengths.

1 micron = 10^{-6} meters

	100,000	microns	= 10 cm	(radar)
"sub" heat radiation	10,000	"	= 1 cm	(sidereal)
	1,000	"	= 1 mm	(radio-heat border)
	100	"	= .1 mm	(heat)
	10	"	= .01 mm	(heat)
	1	"	= .001 mm	(heat-light border)
	.8	"	= .0008 mm	(red)
	.4	"	= .0004 mm	(violet)

1 angstrom = 10^{-10} meters

8000.	angstroms	— red
4000.	"	— violet
1.	"	— medium X rays.

(12) Dec 10, 1942 [35?]

Suggestions as to suitable "semi-dielectric" materials are those which offer:

1. Heat resisting qualities. Capable of operating at temperatures from 600 to 1200 degrees F (dark red heat).

2. Dielectric strength, averaging 25 KV / inch.

3. Proper conductivity to achieve results indicated in P. 33. Conductivity to increase rapidly as temperature rises above 1200 degrees F.

4. Mechanical strength at high temperatures.

5. Capable of maintaining high vacuum within cylinders at high temperatures. (Low permeability)

6. Minimum coefficient of expansion.

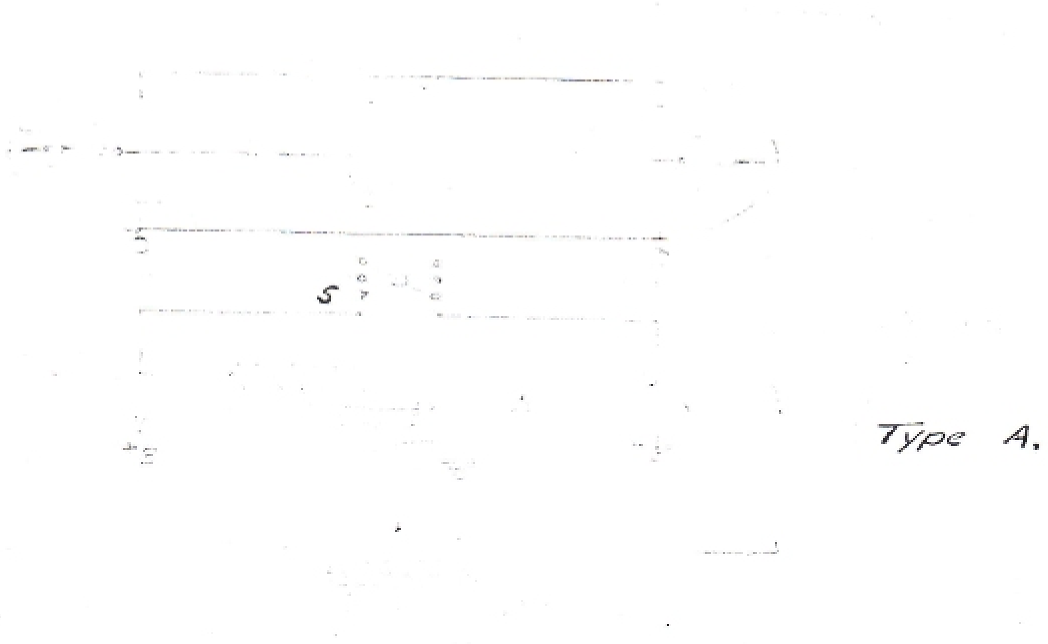
Materials to be considered are:

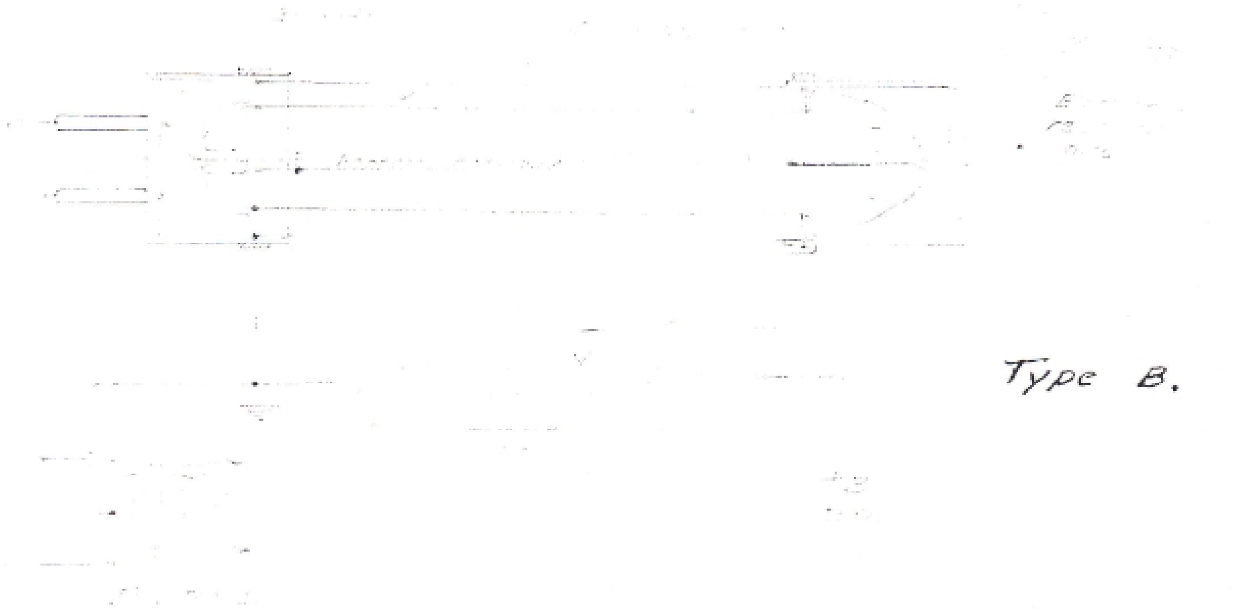
1. High grade refractory porcelains. With various conducting agents, thorium oxide, graphite, etc

2. Boro-silicate quartz glass with metallic ions, carbon or oxides.

(11) Dec 10, 1942 [36]

Several types of small experimental tubes are suggested – as follows:



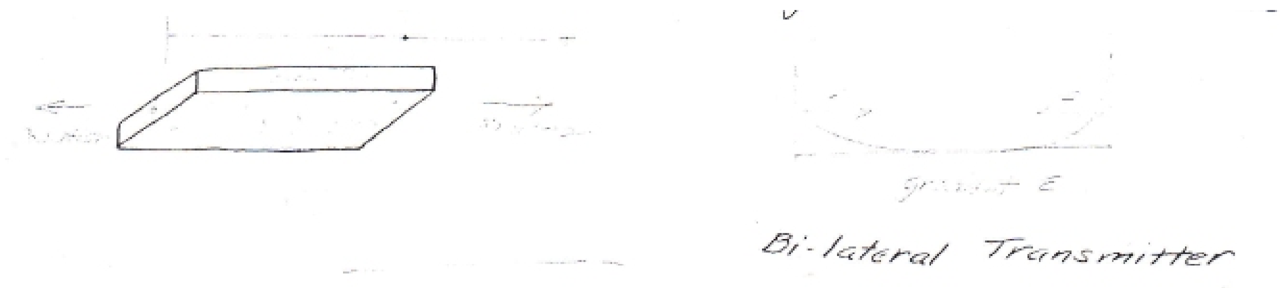


(6) Dec 11, 1942 [37?]

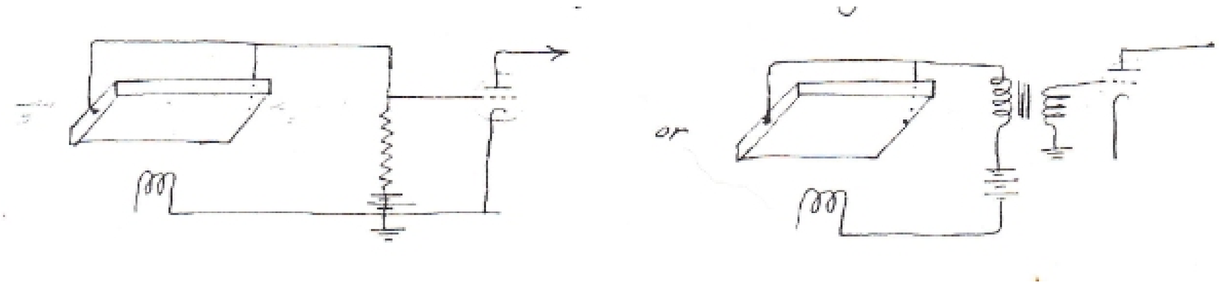
Type A is reversible. For this purpose it is made symmetrical. When the slider on the high voltage potentiometer is moved toward the negative end, the force (or radiation) is increased regardless of the position of direction-reversing switch S. The direction of radiation is always toward the positive electrode, the direction of reactive forces always toward the negative.

Type B is not reversible. The slider controls the force, as in Type A.

Type A may also be used as a bi-lateral transmitter. See P. 28-29. For this application, both ends of the semi-conducting dialectric are made positive with respect to the cathode.

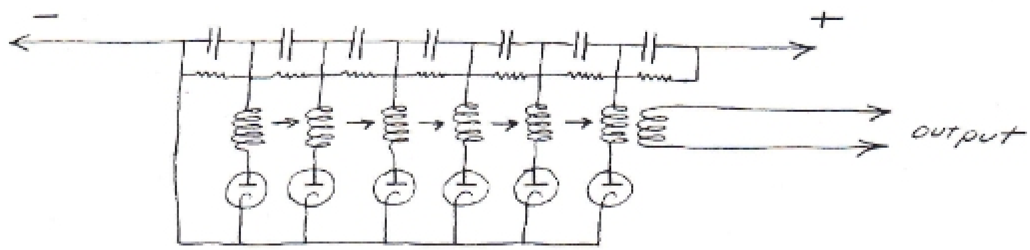


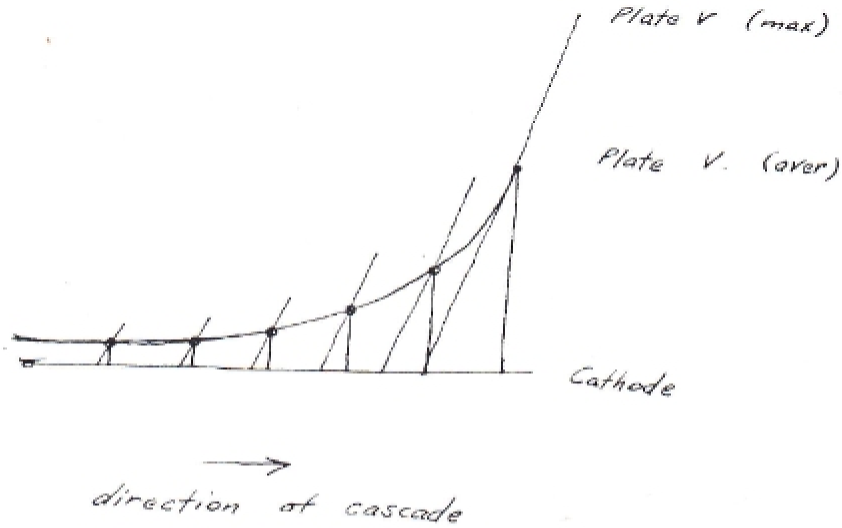
As a bilateral receiver, the following circuit is indicated. Pulsating radiation only.



(8) Dec 15, 1942 [38]

It would seem that the principles herein set forth may be applicable also to a multi-stage low frequency oscillator, where the wave is developed in amplitude by “cascading”. At each stage, additional energy is applied:

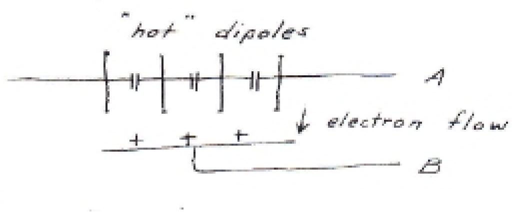




(9) Dec 15, 1942 [39]

Thermoelectric equilibrium.

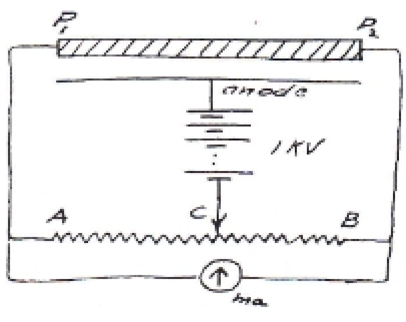
Certain thermoelectric effects are predicted which appear to parallel well-known photo-electric effects. As described in P. 23-25, incoming radiation causes dipole nullation. If the dielectric containing the nullating dipoles is placed in a transverse electric field, electrons are pulled out, current flows, and dipole radiation is “resisted”. The nullation is damped and heat is absorbed. If the heat “supply” radiation is discontinued, the dielectric “cools” until nullation ceases. In this way, the action might be considered “endothermic”. Heat energy is converted into electric current.



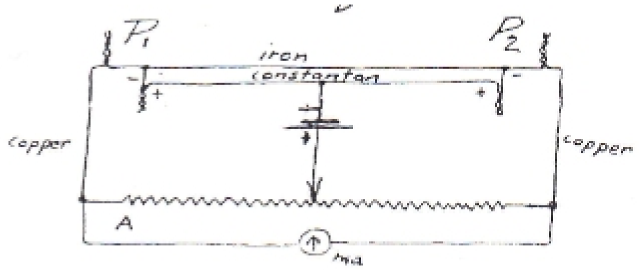
“Hot” dipoles evolve electrons until A becomes sufficiently positive with respect to B, to prevent evolution. The positive charge on A, then, is a function of its temperature. If a conductor of low resistivity connects A with B, a current flows. If losses are present, the dipole oscillation is “removed”. This is

(7) Dec 15, 1942 [40?]

substantially what happens in the case of dissimilar metal junctions of a thermocouple.

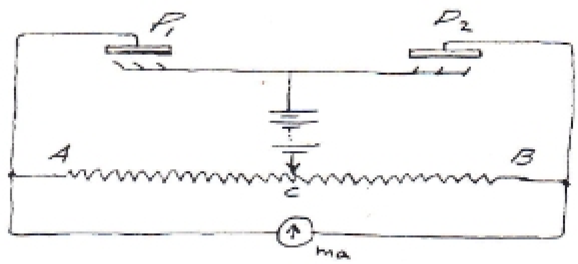


Dielectric and P1P2 is arranged in close proximity to an anode plate as indicated. So long as the dipole oscillation (temperature) of region P1 equals that of P2 the nul position of the potentiometer slider is centered between A and B, at C. If, however, the dipole oscillation, either through direct radiation or by actual temperature, of P1 exceeds that of P2, the nul will move toward A. If the oscillation of region P2 exceeds that of P1, the nul will move toward B. When the potentiometer is centered, the potential difference between A and B is a function of the heat (temperature) or radiation differential. The thermocouple equivalent circuit is:



(14) Dec 15, 1942 [41]

The photo-electric equivalent circuit is:



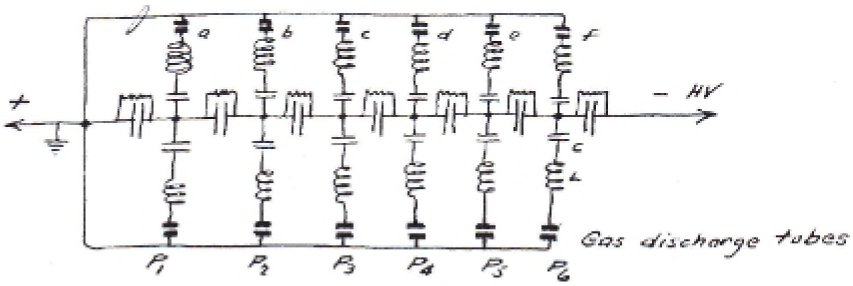
If radiation (light) in photocell P1 exceeds that on P2, the nul moves toward A, and visa versa.

Returning to “sub” heat radiations discussed throughout this theory, the wavelength of the order of 1000 microns appears reasonable. The band may spread from 10,000 microns to 100 microns conceivably. The “radiation to electricity” effects must be substantially the same as with infra-red and light. These effects are observable in the behaviours of certain dielectrics in electric fields.

The type of dielectric selected seems to depend on the wavelength utilized. Longer waves require larger inductance and capacitance per unit volume of dielectric. Furthermore, the more dense dielectrics offer greater natural absorption. Electrical resistance likewise causes absorption.

(15) Dec 17, 1942 [42]

The choice of dielectric depends on several factors. Let us examine closely the action of the radiating system and how it is affected by these factors.



Radiating System

Fig 1

– voltage distribution

Condition with no current flowing at discharge tubes

Fig. 2

– voltage distribution (aver.)

Condition with all tubes "firing".

Fig. 3.

As a starting point, let us assume P3 "fires" due to high potential difference of its electrodes. The resistance of the tube momentarily drops to a low value and the potential of that and of the dipole suddenly changes toward the positive. If the dipole is lambda/2 the potential at c changes toward the negative by an equal amount. But this is far beyond the initial potential, and c fires as a result. This is reflected again at P3, but

(16) Dec 17, 1942 [43]

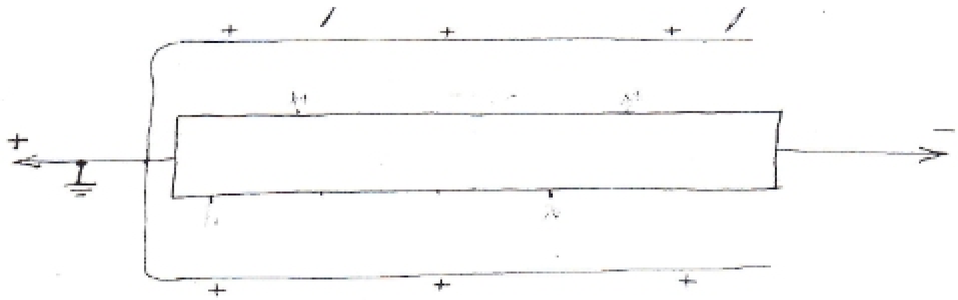
due to the exceedingly high frequency, P3 has not yet recovered sufficiently to fire again, and the dipole oscillates freely and with such damping as results from radiation. When the tube has recovered, it will fire again on one of the upswings followed immediately by the opposite tube.

Returning to the initial firing of P3 and the resultant "tilting" of the dipole, a wave is produced which travels outward and induces a opposite current in neighboring dipoles. Due to the fact that the potential of P4 is higher than P2, it fires first and with a greater expenditure of energy. For the same reason P5 fires and then P6. The wave travels toward the region of higher energy (higher voltage). As the wave front travels along, it leaves a region of recovered tubes behind it, so that a second wave front is initiated which follows the first – both moving toward the region of higher energy. Then a third, fourth and so on – each steep "front" followed by a procession of damped waves.

(17) Dec 18, 1942 [44?]

All tubes will oscillate if the potential of the “lowest” one is beyond the firing potential. Pulses will be followed by a damped train of nullations of the natural period of the dipole. The entire undulating effect travels toward the region of higher voltage. The period of the initial pulses depends upon the recovery time of the tubes.

The effect has a mechanical analogy in the multi-cycle engine, where explosions of the fuel occur only at certain multiples of revolution of the crankshaft.



Phase velocity is approximately the velocity of light.

The factors affecting the frequency of pulses are:

1. Condition of the surrounding space as it affects ion or electron movement. Low relaxation time.

2. Voltage applied.

3. Character of emitting surface.

4. Dielectric resistivity.

5. Dielectric absorption.

(18) Dec 18, 1942 [45]

Factors affecting frequency of natural dipoles.

1. Mode of osillation of the dipoles.

2. Dimensions of the dipoles.

3. The LC product.

Factors affecting the dipole currents, inter-dipole magnetic relations (recoil forces)

1. The LC product

2. Voltage applied.

It is apparent that all the factors are inter-related and it is difficult to separate them.

For maximum radiation and its attendant recoil, the factors may be summarized as follows:

1. Maximum exposed dipole area for radiation into the “outer” system.

2. Sufficient conductivity to maintain high pulsing current & frequency.

3. Highest possible working voltage.

4. Proper gas (ion) content and pressure for optimum current and recovery time.

5. Highest dielectric constant.

6. Highest dielectric absorption.

(19) Dec 19, 1942 [46]

It may be seen, therefore, that pulses will travel successively “down” the line of dipoles toward the high voltage end. Discharge at the dipole ends travels similarly. The phase velocity may be somewaht less than the velocity of light.

The time between pulses or discharges depends on:

1. Period of recovery of positive space charge or negative space charge. “Clean-up” time.

2. Reappearance of absorbed charge in the longitudinal dielectrics.

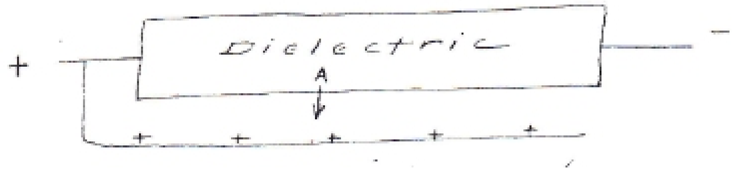
3. Voltage at which the system is operated.

4. Dieletric resistivity, which is a measure of power required.

The reappearance of absorbed charge in the longitudinal dielectrics is mainly responsible for the tilting of the gradient toward the low voltage end, causing the discharge to reappear successively at the low end after it had progressed the length of the dipole system and disappeared.

In effect, the following is a summary of the action which takes place:

(20) Dec 19, 1942 [47]



A glow discharge takes place at some point A on the dielectric. It quickly extinguishes itself due to the current flowing to the spot thru one arm of the dipole (width of dielectric). This arm is an inductance. A magnetic wave travels toward both ends of the dielectric and encompasses other dipoles on both sides in quick succession. The dipole to the right (toward the high voltage end) absorbs energy parasitically, as does the one on the left, and a voltage is induced which is additive to that already present. However, the dipole on the right is already at a higher voltage than teh one to the left, therefore its high negative end “fires” before that of the dipole on the left. When it fires, the current is quickly reversed and reaches a maximum during the “build-up” of the magnetic wave which triggered the action. Mutual net forces are present which tries to move the dipoles to the left. In quick succession, approaching the speed of light (magnetic phase velocity), other dipoles to the right are “fluid” and their forces of mechanical recoil developed. The glow discharge area quickly runs off the high voltage end of the dielectric and disappears.

Following behind the glow discharge area is a

(21) Dec 19, 1942 [48]

dark area where ultra-high frequency waves are surging back and forth across the lambda/2 width of the dielectric. These surges likewise interact in and between dipoles of that area to contribute to the recoil forces, since they are started by and are in phase with the initial travelling pulse.

At some point in the rear of the dark area sufficient absorbed charge of the dielectric becomes present in additive relation that another pulse is initiated. If the ultra-high frequency surges have, by that time, not been damped out by radiation losses, the negative swing will trigger the pulses and a new steep wave front initiated. This will be marked by a glow discharge area which will travel rapidly to the right end and disappear as before.

Naturally, the greatest radiation and recoil forces will result when pulses are close together and the following train of oscillations synchronized and maintained in continuous high amplitude.

This requires correspondingly greater current because of more frequent pulsing. This current is maintained by the high voltage through the dielectric resistance.

To add electrical inertia to the oscillating dipoles the L and C of the dielectric is as high as possible. Therefore, a material of highest specific inductive capacity is employed.

(22) Dec 19, 1942 [49]

The dimensions of the dielectric are important.

The simplest radiator is a dielectric lambda/2 width so that surge reflections are obtained on the inner faces. The thickness of the dipole affects the current, within certain limitations. It must be remembered that the speed of the surges will not be the speed of light, but something less. The amount less depending directly upon the specific inductive capacity of the dielectric.

In other words, the dipoles should be shorter, the higher the dielectric constant, to maintain a certain wavelength. But, it is indicated that the added electrical inertia is a decided advantage, both to maintain continuously high currents in the dipoles but to derive greater energy of oscillation (and very much less damping).

Naturally, the initial energy of the pulse, to set the dipoles oscillating, will be correspondingly greater. It may turn out that metal sheets will be the “ultimate” material for the dipoles, whereas a

dielectric of high absorption and low resistivity the “ultimate” for the longitudinal condensing spacers.

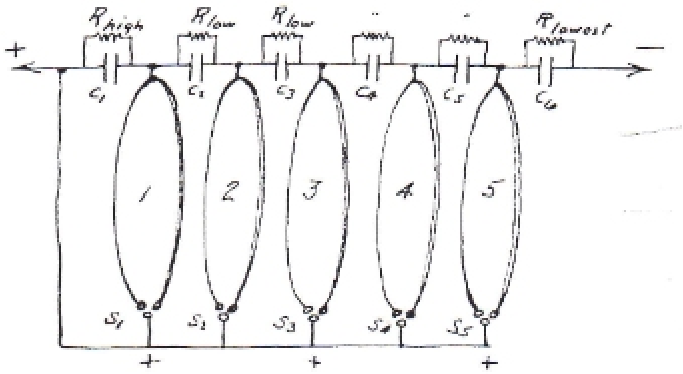
Another dipole shape is the disc. In this case, the center is one pole and the periphery the other. Oscillations would cause circularly polarized waves. See P. 14.

(23) Dec 19, 1942 [50]

Another form of dipole is the ring, where the inner surface of the ring constitutes one pole and the outer surface the other pole. This form was suggested in P. 16, 32, 33 and 36. It has the advantage of internal excitation, leaving the outer surface unobstructed for radiation.

The Hertzian Loop Design

Pursuing ideas advanced (P. 49) as to the “ultimate” materials for both lateral and longitudinal dielectrics, the following type of construction appears to warrant consideration. Essentially, it is a series of Hertzian Loops with condensers beween them at the nodes:



Let us assume that a spark jumps initially at S3, from one leg or pole of the loop to the positive and of the HV feed. For this purpose a 3-pole spark gap may be employed.

(24) Dec 21, 1942 [51]

A heavy current flows momentarily upward thru the leg of the loops. An expanding magnetic field envelopes the adjacent loops, and equal emfs are induced in the loops on both sides. Since loop No. 4 is already at a higher potential than No. 2, its gap will “fire” first. Due to the fact that the magnetic field from No. 3 is still increasing when current flows in No. 4, recoil forces are expected on No. 4 in the direction of No. 3. (Conductors carrying currents in the same direction.)

No. 5 fires as a result of the triggering inductive emf of No. 4 (plus residual induction from No. 3.)

When their associated condensers have been discharged, Nos 3, 4 and 5 become inactive successively. But No. 1 then initiates the fire which passes in succession to No. 2, 3, 4 and 5, and then repeats. Recovery comes about by the re-appearance of absorbed charges in the condensers. For this reason a material of high dielectric absorption should be chosen. In order to discharge relatively high currents at frequent intervals the condensers must be of low resistance or else a separate resistance should be shunted across each one except C1. This condenser should have high absorption and high resistance.

(25) Dec 21, 1942 [52]

Perhaps a better arrangement would be to use separate resistors, with those of higher value toward the left (referring to the diagram) – and those of lower value progressively to the right. This would bring about a more uniform voltage distribution when all units are firing.

In the foregoing description the travel of the initial pulse from the low voltage end to the high voltage end was indicated. The radiation (to the right) and the recoil (to the left) was predicted. However, it must be remembered that the initial pulse is followed by a train of UHF waves or oscillations in each loop and that appreciable UHF currents are flowing in adjacent loops. It is believed that the phasing of these currents bears the same relation from one loop to another as the initial pulse. Consequently, recoil forces are developed so long as oscillations persist. The damping is caused by the losses due to radiation, and energy must be periodically applied by the pulses to keep the loops oscillating. It is believed that the oscillation of metallic loops will persist longer (and with less damping) for a given radiation resistance than that of dielectric loops – due to greater electrical inertia. See P. 49.

(26) Dec 21, 1942 [53]

The 3-pole spark gaps shown in the diagram of P. 50 may be replaced by a 3-pole gas discharge tube or two 2-pole tubes. A tube of minimum recovery time is desirable – to increase pulse frequency. Perhaps a full wave rectifier tube, either gaseous or high vacuum can be used to advantage. In this case, the filament would have to be negative and the polarity of the system, as shown on P. 50, would be reversed.

All of the systems shown so far have been “self pulsing”. The pulse period has been dependent on circuit conditions, such as, dielectric absorption, capacitance, clean-up time, transit time, potential applied, etc. The total net radiation of UHF and the recoil forces are dependent only upon the proper phase relationship of successive loops and the maintenance of oscillations at maximum amplitude against damping due to radiation resistance. (See P. 43)

To maintain oscillations at maximum amplitude, high energy pulses must be applied as rapidly or frequently as possible. Increasing longitudinal capacitance increases the energy of the pulses (current floor) but likewise increases the pulse period when self pulsing or relaxation circuits are employed.

To obviate this, “controlled” pulsing is indicated.

(27) Dec 21, 1942 [54]

<u>Controlled Pulsing</u>

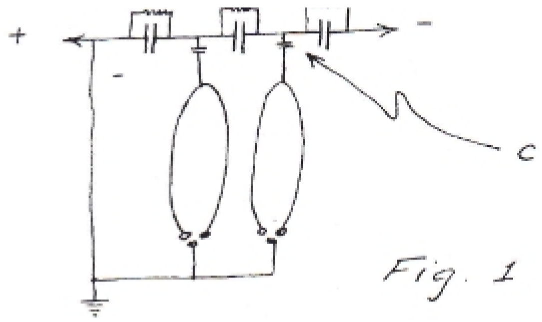
Any standard oscillating circuit may be utilized to initiate and control the pulse of the first Hertzian loop. Naturally, the power required increases with the frequency. Also, the recoil forces are proportional to the pulse freq at low pulse frequencies. At high pulse frequencies proportionality disappears and the force becomes some lesser direct function of the pulse frequency. In this respect the pulsing of the system becomes a means of control both for the net radiation and for the recoil force as well.

It may be seen, then, that the system of Hertzian loops form essentially a relaying system which is also a power or radiation amplifier. Power is consumed in reinforcing and directing the radiation. The No. 1 loop is the control loop and all others merely reinforce the radiation of No. 1 as it travels along – triggering each one in succession. The energy comes from the DC high voltage source, and

the gain is dependent upon the voltage gradient between successive loops. Since the potential of each loop drops “almost to zero” in the passage of each pulse, it is apparent that a considerable amount of power is consumed at high voltage when pulsing at high frequency.

(28) Dec 22, 1942 [55]

To limit the firing time in such a way as to prevent loss of efficiency, a condenser of lower capacity than the longitudinal condenser may be placed in the circuit between the loop and the potential divider.

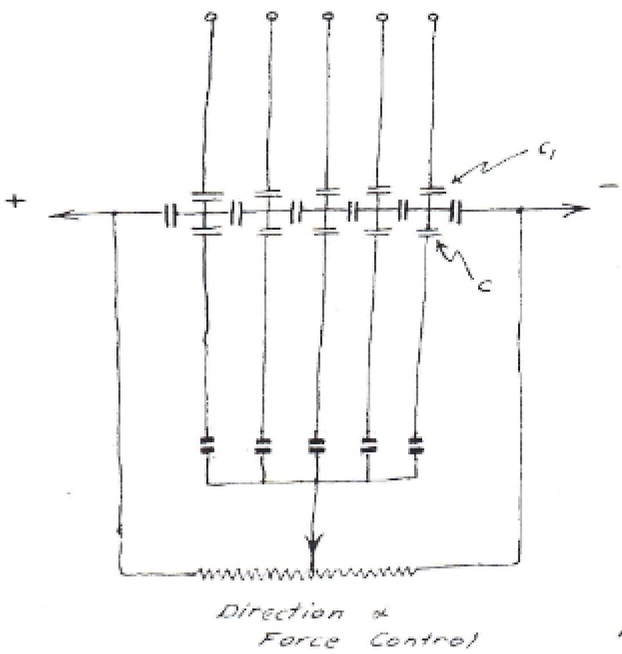


Discharge - time Limiter

Fig. 1

This will assist in understanding the last paragraph of P. 54.

Gas discharge tubes may be employed in place of spark gaps, with resulting gain in efficiency.



Glow-discharge Tubes. Shown with dipoles instead of Hertzian loops. (with discharge-time limiters) C₁ used for balance.

Fig. 2.

(29) Dec 22, 1942 [56]

It will be observed that the discharge-time limiters shown in Fig. 2 will increase the LC product and consequently reduce the frequency of the UHF. This is not so with the arrangement shown in Fig. 1.

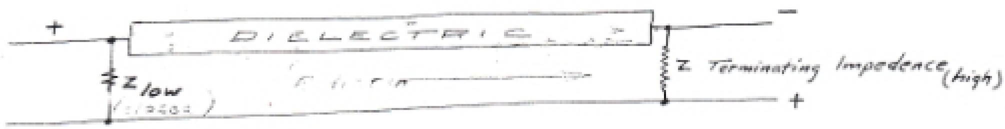
<u>Extent and Direction of Radiation controlled by Impedence of Transmission Line</u>

In practically all of the foregoing explanation, the radiation was supposed to have arisen from the action of a wave train travelling toward the high voltage end of the dipole system. In this respect the

action would be similar to that of the end-firing Beverage antenna. It is noted, however, that the Beverage antenna must have a terminating impedance which differs "slightly" from the characteristic impedance in order to cancel or absorb the backward reflections, thus creating uni-directional action.

The possibility that this may also be the case with the self-excited dipole system is quite important. It is desirable to give the matter consideration at this point. For this purpose, the dipole system and its associated “reactor” plate or field is thought of as a parallel transmission line.

(30) Dec 23, 1942 [57]



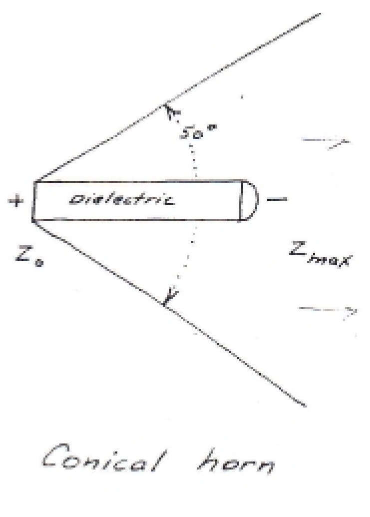
Any disturbance in the electric field along the surface of the dielectric, such as that caused by the emission or arrival of charges, will travel as transients in both directions. They will be reflected at Z low and not from Z high. The net result is radiation off the "open" end only. Radiations of a comparatively broad band of frequencies will be generated and radiated.

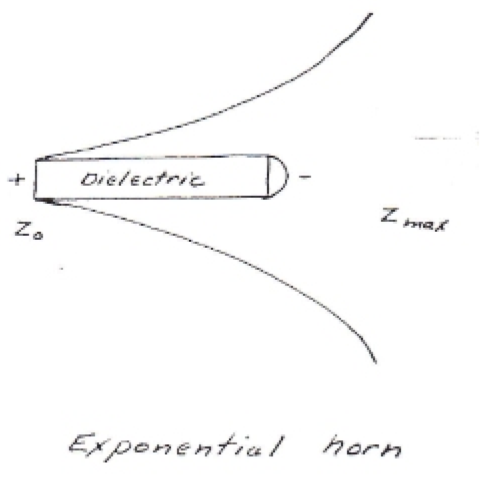
Since the "generator" operates because of the many rapid and aperiodic changes in the field between the dielectric surface and the adjacent conductor of the transmission line, the "effect" is that of electric noise with a flat and broad coverage of UHF frequencies. All the energy of this "noise" will be radiated uni-directionally, as shown. Due to the frequency distribution, the total amount of energy so radiated can be considerable, and depends only upon the electric fields and current available.

The principal source of loss appears to come about through the surface resistance of the dielectric and the adjacent conductor, and to a lesser extent because of internal resistance.

(31) Dec 23, 1942 [58]

If the foregoing “impedance hypothesis” is correct, certain changes in design are indicated which might improve the results. At least, they would serve as a test of the hypothesis.





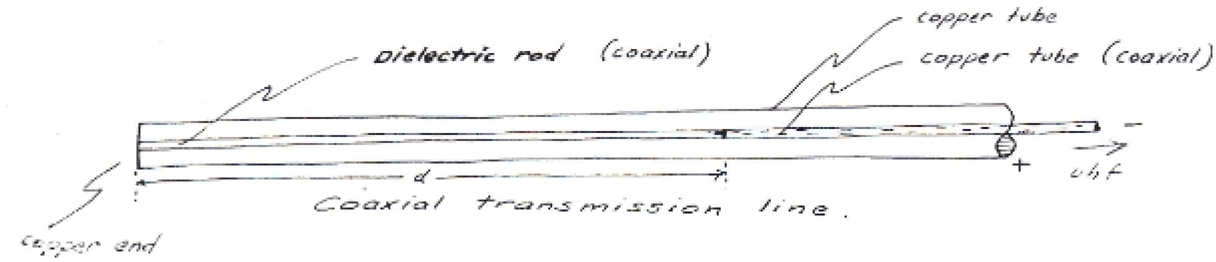
The inner face of the horn should be smooth, polished if possible, and of highest elec. surface conductivity.

The dielectric should be smooth and of max (?) surface conductivity at UHF. Sufficient direct current (or volume) conductivity should be provided to replace and redistribute lost or displaced charges.

It is reasonable that a "field" of positive ions around ionizing wires could replace the horn, tho it is difficult to reconcile such ation with the required low surface conductivity of the horn. It is possible that the UHF is conducted by the field in the same fashion as it is conducted along the surface of a conductor.

Since heavy and large ions (+) are desired, some special ionizing means should be provided.

(32) Dec 23, 1942 [59?]



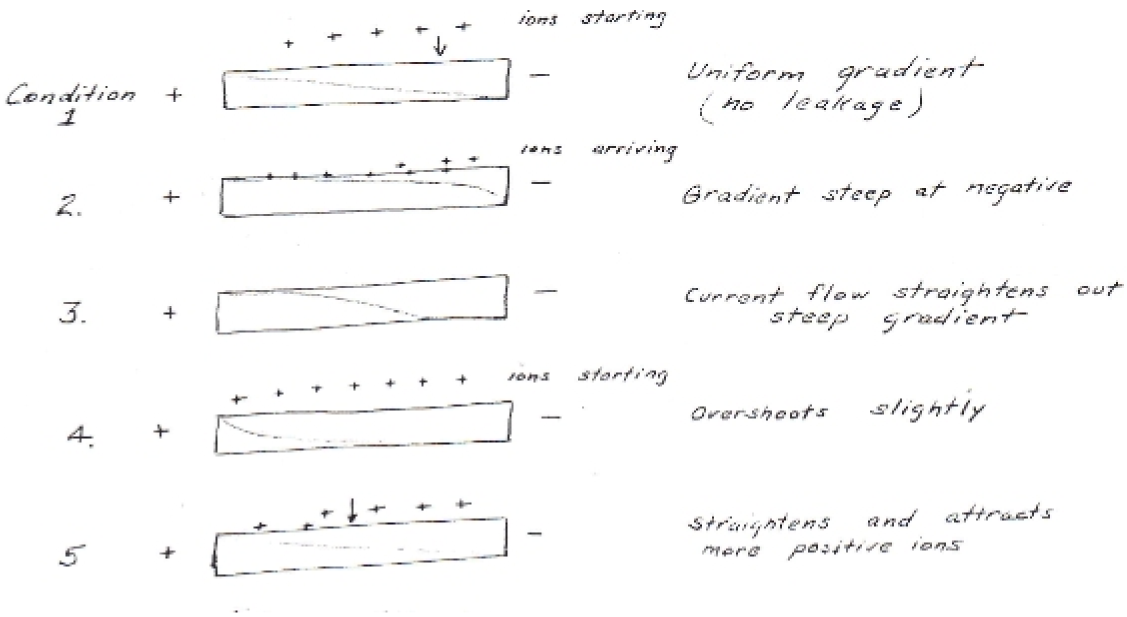
Ions escaping from or impinging on the dielectric rod cause a momentary shift in electric gradient. This results in the formation of an electric wave. As this wave travels along (both ways) on the surface of the rod (and in the surrounding space to the wall of the cable) it affects the arrival of other ions, producing a train of waves of various frequencies. Those waves travelling toward the closed end are perfectly reflected. Those waves travelling toward the open end continue in that direction and are picked up by the copper tube and transmitted along the coaxial cable as shown.

This radiation must form an exceedingly broad band of frequencies - noise frequencies - and consequently could represent great amount of radiant energy. It is probably similar, and closely ralated to thermal noise in common radar circuits.

(33) Dec 23, 1942 [60]

<u>Relaxation Surges</u>

Certain undulating movements of the electric gradient undoubtedly are present, especially when the ionization envelope is not stable. This relaxation effect surges back and forth longitudinally in a long dielectric under strain. <u>Transit time</u> of ion clouds is principally responsible.



The frequency (fundamental) of such relaxation surges is an inverse function of the length of the dielectric and a direct function of the voltage.

Surges of this nature may, conceivable, produce an additional radiation from the unclosed end of the transmission line. P. 58.

(34) Dec 23, 1942 [61]

Such a relaxation oscillation causes the field in the dielectric to be progressively distorted, first in one direction, then in another. The result is equivalent to a potential reversal at points in the center of the dielectric.

<u>Resistance of dielectrics at ultra high freq.</u>

Certain dielectrics possess lower resistance at high frequency than at low freq. or d.c. A rigorous theoretical framework is:

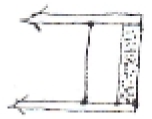
$$r = R_0 \left[1 + \left(\frac{1}{12} \frac{2\pi F S \mu}{R_0 10^9} \right)^2 - \left(\frac{1}{180} \frac{2\pi F S \mu}{R_0 10^9} \right)^4 + \cdots \right.$$

where r = ac resistance (uhf)
R_0 = d/c
S = length (cm)
μ = permeability
F = freq. in c/sec.

Ref: A new method for measurement of ultra-high frequence impedance, Seeley and Bardem, License Laboratory, R.C.A.

Example:

Carbon resistor 5300 Ω D.C
4100 Ω 50 meg.
3600 Ω 100 meg.



#18 wire – high res. at high freq.
low " at low freq.
Carbon resistor – low res. at high freq.
high res. at low freq.

middle band pass filter.

(35) Dec 24, 1942 [62]

It is understandable, therefore, that the dielectric material which is considered in this application (P. 56 etc) should have <u>low</u> UHF resistivity. Transients are conducted by the system without much loss. They are reflected by the closed end of the "transmission line" and are radiated at the other end, similar to the end-face of the Beverage antenna.

It is possible that suitable dielectric materials would include carbon resistors, lead monoxide-paraffin, slate, marble, leaded bakelite, porcelain-graphite, porcelain-thorium oxide, boro-silicate-quartz glass with metallic oxides in carbon. See P. 34.

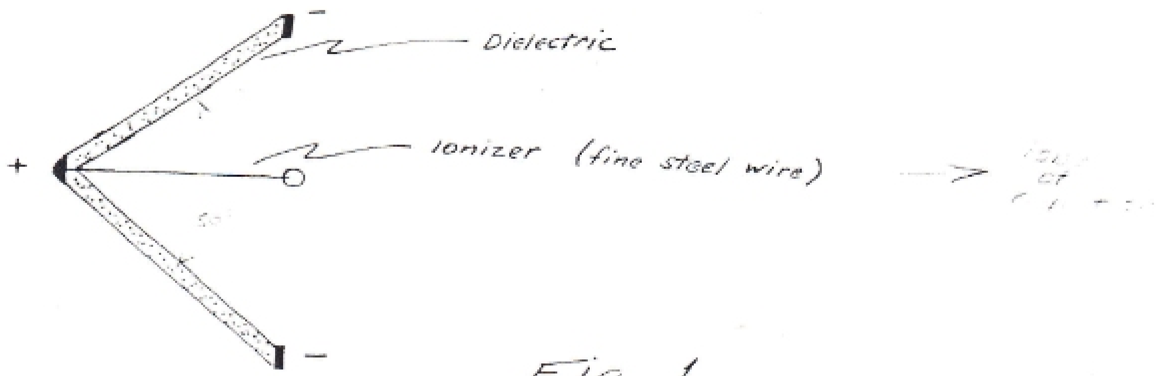


Fig 1.

The advantages of the design shown in Fig. 1 are as follows:

1. Conical reflector for maximum lobe, approx 50 degrees.

2. Desirable (linear) direct current gradient.

(36) Dec 24, 1942 [63]

3. Centralized positively charged ionizer. Highest gradient near the ionizer rather than the dielectric.

4. Proper spacing and arrangement of parts for high voltage.

5. Activated surface or inside of cone for maximum directed radiation.

<u>Hot cathode emitter</u>

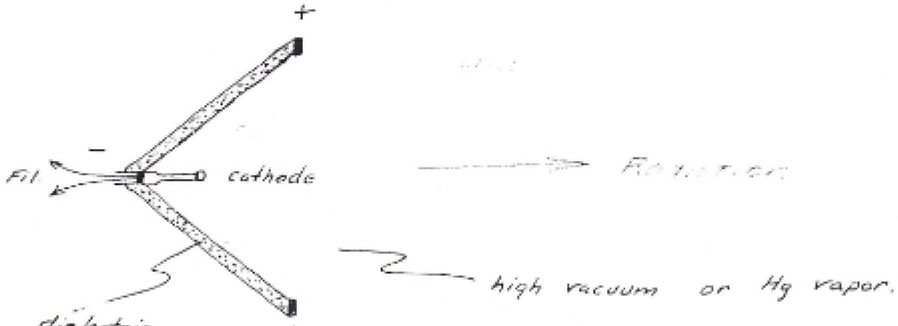
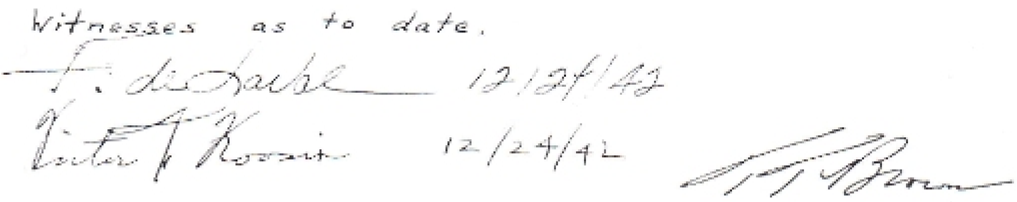


Fig. 2.

Advantages:

1. Higher current - greater radiation.

2. Probably a higher frequency, particularly when the tube is evacuated and a high voltage is used.



Witnesses as to date.
[F. de Speke?] 12/24/42
[Lister Rocsin?] 12/24/42
[T T Brown]

(37) Dec 26, 1942 [64]

To develop the hot cathode emitter outlined on P 63, the following requirements are indicated:

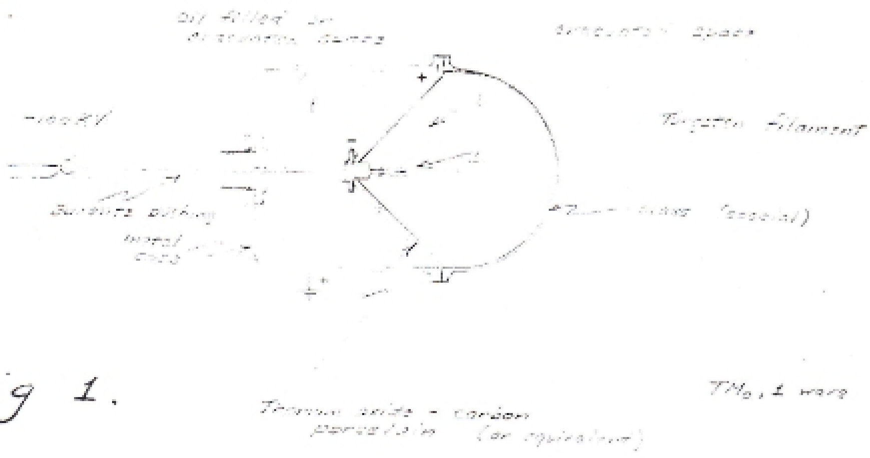


Fig 1.

The initial electrostatic condition of the dielectric in Fig. 1 is such that the steepest gradient exists near the negative electrode. As soon as electrons begin to arrive in this region the steep gradient

shifts progressively toward the positive pole. The electron flow follows the gradient. Soon a situation exists where the electron flow substantially short circuits the dielectric current and the electrostatic condition quickly returns to the initial state where the steep gradient is near the negative. Thus the cycle is repeated. Thee gradient and its associated potentials and currents surge back and forth. These relaxation surges were described on P. 60. The frequency is an inverse function of the distance travelled, ie, the length of the dielectric

(38) Dec 26, 1942? [65?]

and a direct function of the applied voltage.

This is the fundamental or lowest frequency.

If the sides of the dielectric conde measure 10 cm, and the proper voltage is applied, 20 cm. radiation is produced. It is concentric and radially polarized, [A] and the cone acts as a horn and impedance-matching wave guide. at the same time a whole series of harmonics and "noise" radiations of exceedingly high frequency are produced by the "splashes" of groups of electrons landing on the dielectric. * Due to the low AC resistance of the dielectric at these frequencies (P. 61) (probably of the order of 1cm. to .1mm wavelength) these waves travel almost without loss in both directions along the dielectric. Those waves travelling toward the apex of the cone are reflected (P. 56-59) and, together with those already travelling in the other direction, leave the cone at the base as radiat energy. The angle of the cone determines the sharpness of the directed beam. Following information (empirical) already at hand regarding the performance of wave guide horns, 50 degrees appears to be the optimum.

Cooling of the dielectric may be necessary. This can be accomplished by a oil-filled space backing the cone. Cooling fins can be arranged on the outside of the case.

On the other hand, it may be found desirable to permit the dielectric to “run hot” for several

* See P. 64
[A] TM0, 1 wave.

(39) Dec 26, 1942 [66]

reasons:

1. Conductivity of this type of dielectric increases with temperature.

2. This would permit a natural balancing action between the dielectric conductor current and the electronic current from the hot cathode.

3. Thus, if a resistor is placed in series with the HV lead, the temperature would balance at any voltage value.

4. Hot dielectrics may give rise to additional dipole activity and an additional spread of ultra high frequencies. In a sense, re-radiation of the heat energy in the form of quasi-heat radiation. (See also P. 39).

<u>High-energy pulsing for radar purposes</u>

Energy stored in a high voltage condenser may be applied to the dielectric of the quasi-heat radiator. The duration of this pulse is determined by the capacity of the condenser, current consumed, and the design of the pulsing current. It should be of the order of 3 mu sec. and as square a wave as possible.

Another method of pulsing, of somewhat low power however, is the use of a grid around the filament of the quasi-heat radiator. In this type of system, the potential on the dielectric would be maintained and the “plate”

(4) Dec 28, 1942 [67]

current triggered by the field on the grid.

<u>Radar Receiver</u>

This radiating system may be used as a receiver as well. Radiant energy will cause the extremities of the dielectric to become differently charged. Audio amplifiers must then be used to bring the signal up to the desired level to operate the “scopes”. No radio frequency current is employed, except that in the antenna-rectifier system.

Another receiving system might utilize the variations in the cathode to plate current. Fig. 2.

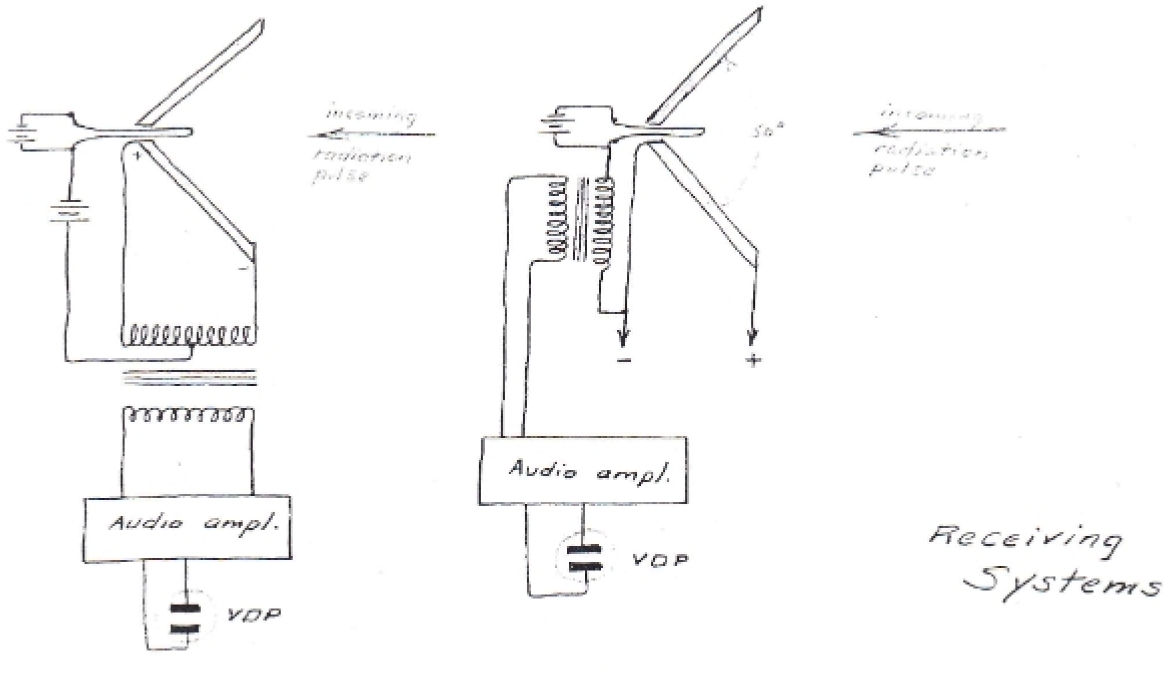


Fig. 1 Fig. 2.

(3) Dec 28, 1942 [68]

Quoting from P. 391 - Lindenblad: Transmitters for Frequencies Above 300 MC – Radio at Ultra High Frequencies, RCA Institute Technical Press

[Transcriber: This document is online as of 2024: https://www.worldradiohistory.com/ARCHIVE-RCA/RCA-Review/RCA-Radio-at-Ultra-High-Frequencies.pdf “RADIO AT

ULTRA-HIGH FREQUENCIES: Technical Papers by RCA Engineers on Propagation, Transmission, Relaying, Measurement, and Reception Above 30 MC. Edited: LEWIS M. CLEMENT, RALPH R. BEAL, DR. H. H. BEVERAGE, ROBERT S. BURNAP, DR. ALFRED N. GOLDSMITH, CHARLES W. HORN APRIL, 1940" The paper referenced is at page 397, not 391. "DEVELOPMENT OF TRANSMITTERS FOR FREQUENCIES ABOVE 300 MEGACYCYLES BY N. E. LINDENBLAD R.C.A. Communications, Inc., Rocky Point, L. I., N. Y." The quote begins at the end of page 402.]

"The electric field from the electron, which at a distance covers the electrode fairly uniformly and causes a current of no definite origin to flow through the electrode, as the electron moves, becomes more concentrated as the electron nears the electrode. The current origin in the electrode becomes more and more defined into a spot under the electron where it becomes very concentrated. The direction of this current is towards the spot if the electron is in an approaching state and away from the spot if the electron is in a receding state. - - - -

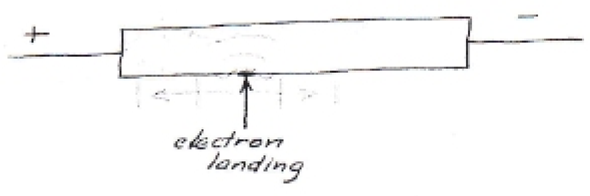
This phenomenon is naturally extremely rapid in that such concentrations do not become noteworthy until the electron is fairly near the electrode. It takes place during a very small fraction of the total transit time of the electron. Its period is therefore greatly in excess of that represented by the transit time and represents real ultra high frequencies. These "surface oscillations" are independent of the frequency at which the device generates and depend only upon the number and velocity of the electrons.

Carrying the discussion a little further it becomes increasingly difficult to see where to draw the line between these "spot impulses" and heat quanta. It depends largely upon the size of the area under consideration if the period belongs to the radio frequency region or the heat region. If the electron is headed for a landing on the electrode the spot becomes smaller and smaller until we reach the molecular and atomic structure of the electrode where the remaining kinetic energy is interchanged.

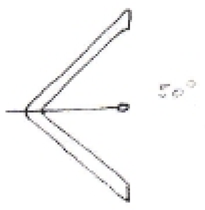
If the electron does not approach the electrode quite so close, like for instance when an electron passes through a grid structure the frequency produced, while high, is definitely one far below that of heat."

(5) Dec 29, 1942 [69]

The arrangement of dielectric shown in Fig 1 of P. 62 differs radically from that described earlier in these notes. It is the thought that the transients caused by the landing of electrons on the dielectric are transmitted principally along the surface where the electrons land. Internal waves induced in the dielectric are perfectly reflected by the opposite surface. These internal waves do not reach the outside, because of the great difference in impedance.



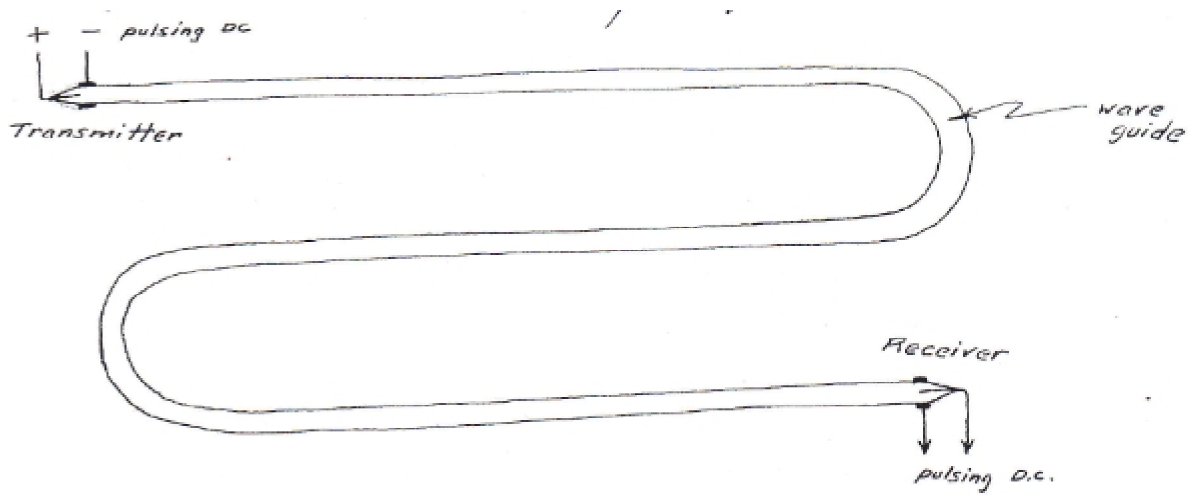
Therefore, radiation is present in the space between the walls of the dielectric cone occupied by the ionizing wire or cathode. These radiations leave the cone at the "open" end and are beamed by the 50 degree optimum angle.



No radiation is present on or from the back of the cone. This applies only to “splash” radiation. Relaxation frequencies are undoubtedly present on the back side, but of less magnitude than in front.

(2) Dec 29, 1942 [70]

Wave guide transmission of “splash” radiation.



1.

Radiant dielectrics are installed at the ends of a wave guide (tubing).

2. If the dielectrics are of the proper type for low-loss transmission, the internal radiation may be transmitted and received, using a solid dielectric wave guide instead of metallic tubing. The system bears a striking resemblance to an elementary nerve structure, where the nerve fibre is a dielectric wave guide.

If such a relation does actually exist, it is possible that radiations of from 10 mm to .1 mm wavelength may have interesting effects on the nervous system, and that certain mitogenetic radiations may be identified as lying in this frequency region.

Pulsing discharges are possibly transmitted along the nerve fibre to create equivalent electrical pulses at the receiving end. Thus a nerve fibre is visualized as a wave-guide (dielectric fibre), capable of transmitting UHF “splash” radiations, and not a kind of organic electrical conductor for the low frequency nerve or muscle-activating pulses. Reference: “Researches of the Johnson Foundation”.

[*Transcriber's note 2024-07-02: I'm now certain that Townsend's word here is "mitogenetic" and not "mutagenetic". The difference is important, and hints at Townsend's later interest in "electroculture". See eg https://www.nature.com/articles/216169a0 :*

Letter Published: 14 October 1967 W. S. METCALF & T. I. QUICKENDEN Nature volume 216, pages 169–170 (1967)

BETWEEN 1920 and 1935 a great deal was published on the subject of mitogenetic radiation—a radiation usually considered to be ultraviolet, which is emitted by dividing cells and which stimulates other cells to divide. These studies were originated by Gurwitsch1 and are still carried on in the Soviet Union, but almost ceased in Britain and the United States in the 1930s after much careful but negative work2–4. Nobody there was able to stimulate cell division with weak ultraviolet light or to detect radiation from rapidly dividing cells with photoelectric or biological detectors.]

(78) Dec 30, 1942 [71]

<u>“Splash” Radiation</u>

Pursuing the hypothesis contained in P. 65 and 68, a further discussion of radiation produced by accelerating electrons is indicated. This radiation has its origin in the radial currents to (or from) the spot where the electron is about to land (or is receding from) on the electrode. It is therefore termed "splash" radiation.

Normally, magnetic reactions between conductors of splash currents cancel one another. If, however, voltage gradients are present, so that a non-uniform current distribution exists, then an overall force results in the direction of the lower current. Fig. 2.

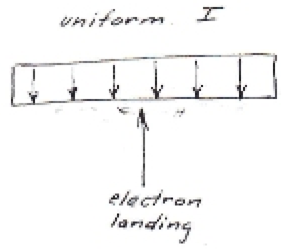


Fig. 1.

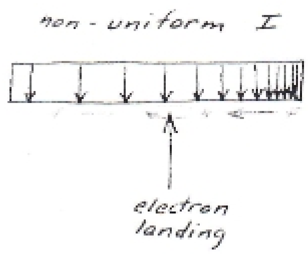


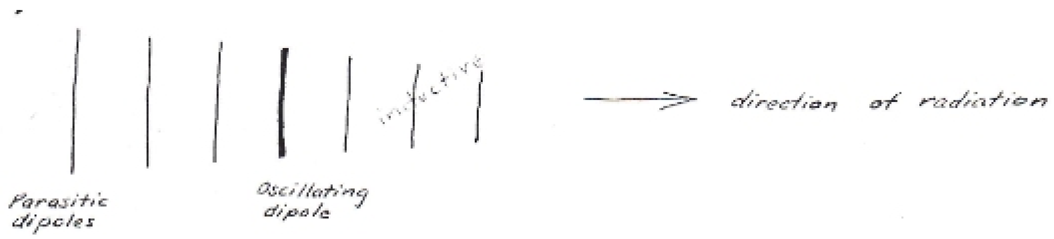
Fig. 2.

This is difficult to explain - except on the assumption of "granular" currents induced individually by periodic arrival of electrons on the electrode surface. The force is a direct function of the electronic current and the lateral voltage gradient.

Radiation is “reinforced” in travelling toward the high-voltage end of the dielectric. One explanation is

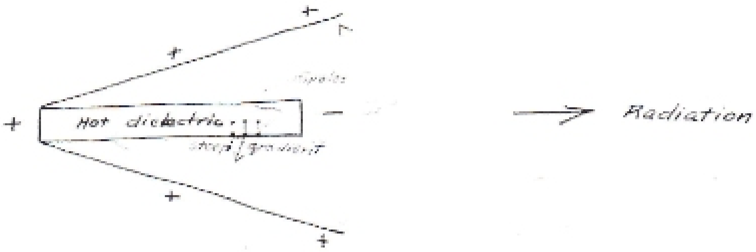
(79) Jan 1, 1943 [72]

that the high-voltage end “appears” inductive, the low-voltage end capacitive - due to electron speed or frequency of electron arrival. The effect is similar to an increasing frequency (natural) of parasitic antennae, producing absorption or cancellation in the capacitive direction and reinforcement in he inductive direction.



<u>Hot-dielectric cathode</u>

Returning for the moment to consider the "hot" dipoles mentioned on P. 39, interesting possibilities seem to present themselves.



Due to the fact that the gradient is steepest near the cathode, the conditions for "starting" electrons in optimum phase relations are present. Furthermore, electrons are emitted more accurately from the negative band of the splash wave as it enlarges. Reaction currents, therefore, are greater.

(80) Jan 1, 1943 [73?]

Heat energy, derived from the ohmic resistance of the dielectric, causes oscillation of the dipoles. Considering only the dipoles nearest to and normal to the emitting surface, conditions are present wherein electrons are emitted when the "outer" pole is negative. Thus the electric field of the dipole is added to the normal gradient at that part of the cathode emitting-surface. Current resulting from fields oscillated by the dipole:

(a) react with fields of other dipoles causing recoil forces

(b) cause radiation which is transmitted progressively toward the inductive end of the system, and radiated into space

(c) result in resisting the oscillation of the dipole and "cooling" the dipole

Therefore, it appears reasonable to believe that the heat of the cathode is continually being converted into a lower frequency and radiated uni-directionally into space.

The energy of this radiation, then, can be considered to come primarily from the ohmic resistance of the hot cathode. The intense radial field (normal to the cathode surface) serving to "direct" the radiation.

One is inclined to believe that the currents in the radial field also contribute energy to the radiation, and that the total radiant energy comes from both the dielectric current and the total "electronic" current.

(81) Jan 1, 1943 [74]

Serving as a plate, a conical metallic member is provided. Considering it a combination plate and horn (for matching impedance), an angle of 50 degrees is suggested. It may be found that an exponential horn is better - depending on the slope of both the impedance and the current curves.

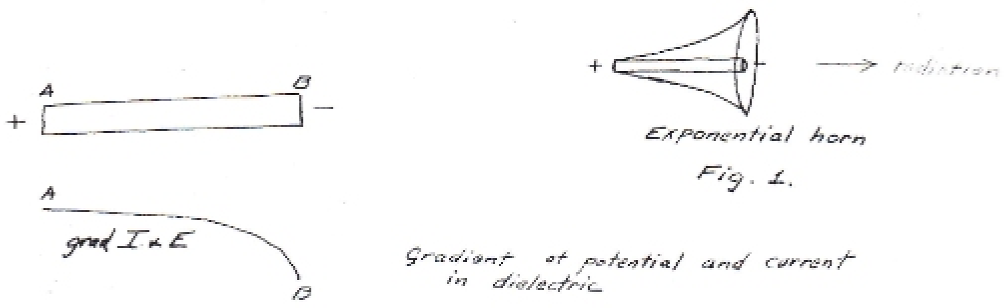


Fig. 1.

If, however, the cross section of the dielectric is altered to correct for the increasing current - making the V-gradient linear - a linear (conical) horn of approx. 50 degrees may be employed effectively.

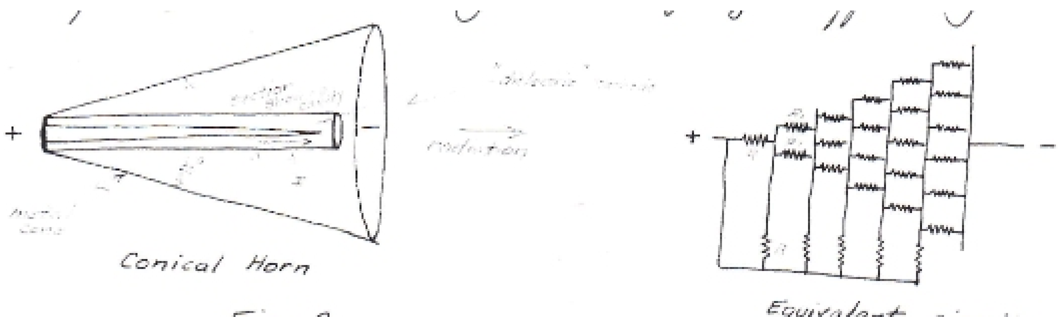
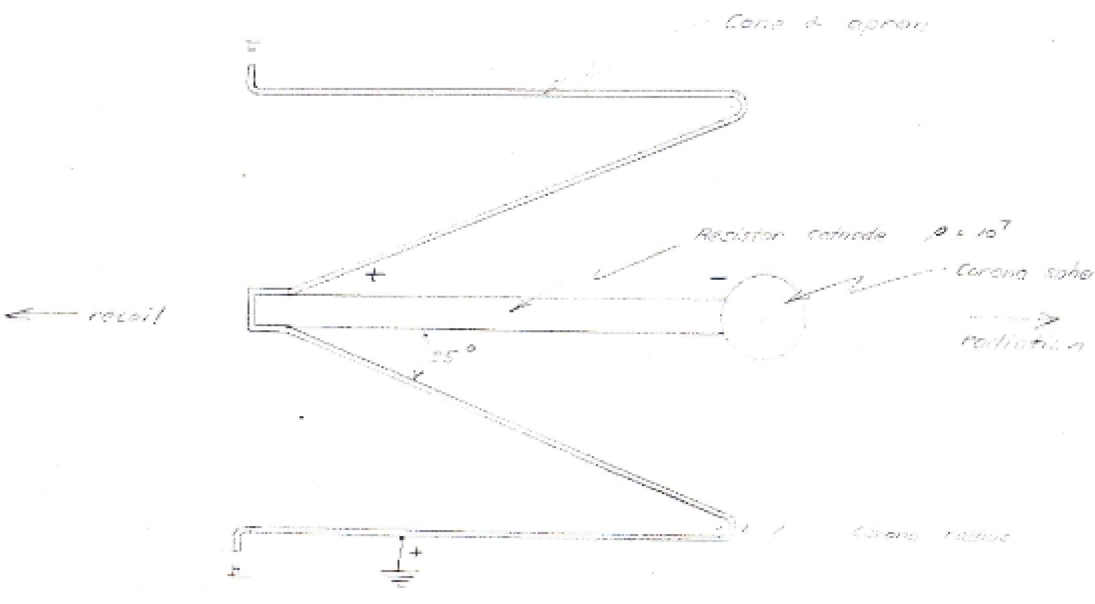


Fig. 2.

It will be noted that the design suggested above is much the same as that shown on P. 33 with the elements reversed in position.

(82) Jan 1, 1943 [75?]



Resistor-cathode (hot dielectric) Radiator

As a practical design the resistor-cathode type has apparent advantages.

1. Highest electric gradient near the dielectric dipole system.

2. Probable transformation or reradiation of ohmic heat into quasi-heat radiation.

3. Positive (front) pole grounded.

4. Using a suitable high-refractory non-oxidizing cathode material, no glass part is required. Space need not be evacuated.

5. Safety-gap provided by corona sphere-to-cone spacing.

6. Dielectric gradient distorted only in accordance with load of plate current. Impedance self adjusting.

Witnessed as to date.

Witnessed as to date

[?] ?/?/43
[T T Brown]

(83) Jan 5, 1943 [76]

<u>Self-oscillating Antenna</u>

High voltage resistor cathodes may have applications in pulse radiators of high power. In such applications they would constitute a self-oscillating antenna system which would be self-contained. The obvious advantage is the elimination of a separate oscillator and transmission line losses, also a considerable reduction in space requirements.

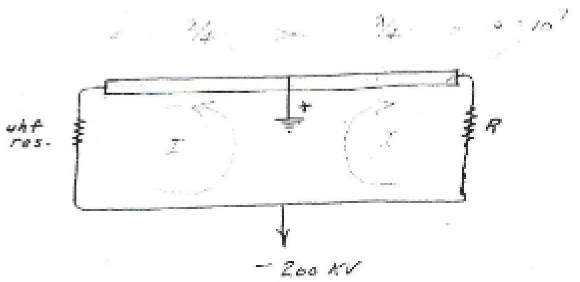


Fig 1.

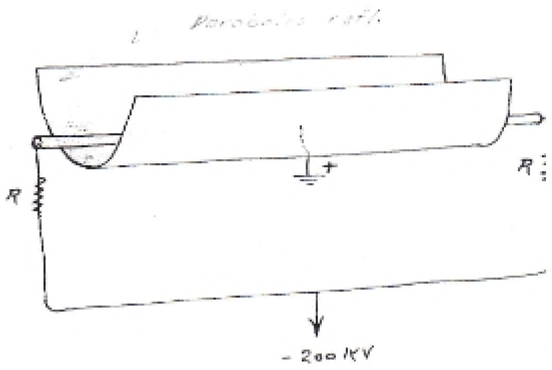


Fig. 2.

Leads to the ends of the resistor-cathode offer low DC resistance and high UHF resistance. Potential is fed continuously, but the oscillation of the dipole is not affected by the external feed circuit. Oscillation is of the relaation type - P. 60 - set up by the dis-similarity of electron escape and the magnetic interaction or feedback between the two circuits of the dipole. The
of the dipole. The parabolic reflector, Fig. 2, acts also as a positive electrode or plate.

Suggested manufacturers of resistor-cathodes:

Glading McBeam
Ohmite – Chicago, Ill.
Pacific Clay Products Co

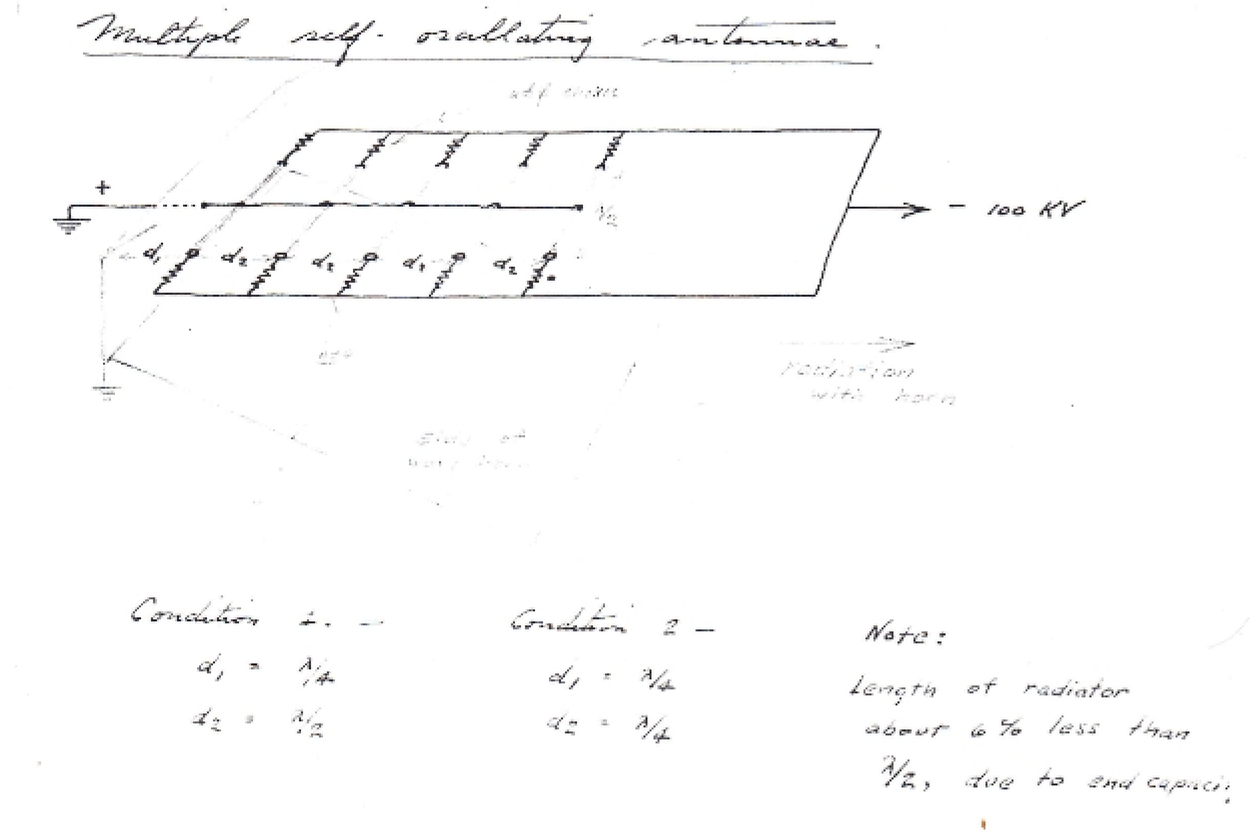
(84) Jan 6, 1943 [77?]

<u>Resistance of cathodes</u> – current requirements

For a radiating cathode as shown on P. 75, the following characteristics are indicated:

Operating potential 200 KV
Operating resistance 10^7 ohms/cm
Current thru resistor cathode 10 mils at 200 KV
Current density (avg.) .5 mil / cm^2
Length for operating potential 40 cm
Diameter 5 cm or area 20 cm^2
Dielectric strength 5 KV/m
Ohmic heat 2000 watts
Operating temperature 1000 degrees F - See P. 34
External electronic current - 10 mils at 200 KV
Total - 4000 watts (basis - 50 ohmic heating)

<u>Multiple self-oscillating antennae</u>



(85) Jan 12, 1943 [78]

Influence of a magnetic field

A magnetic field coaxial with the cones shown on P. 64 and 75 will undoubtedly affect the oscillation. The tendency would be, probably, to lower the frequency and increase the amplitude. In the consideration of the systems it would be helpful, therefore, to include the magnetic field.

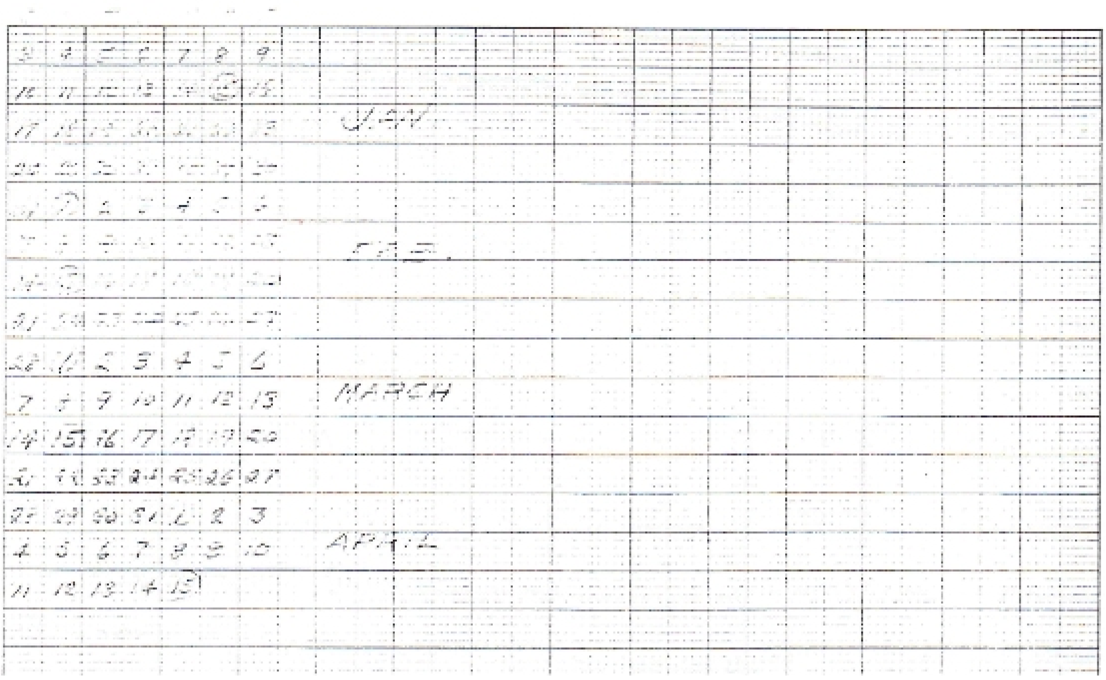
The effect is to increase the length of electron path by causing the electrons to spiral. Since more electrons would be "in transit" at any instant, the negative space charge likewise would be increased.

(86) [79]

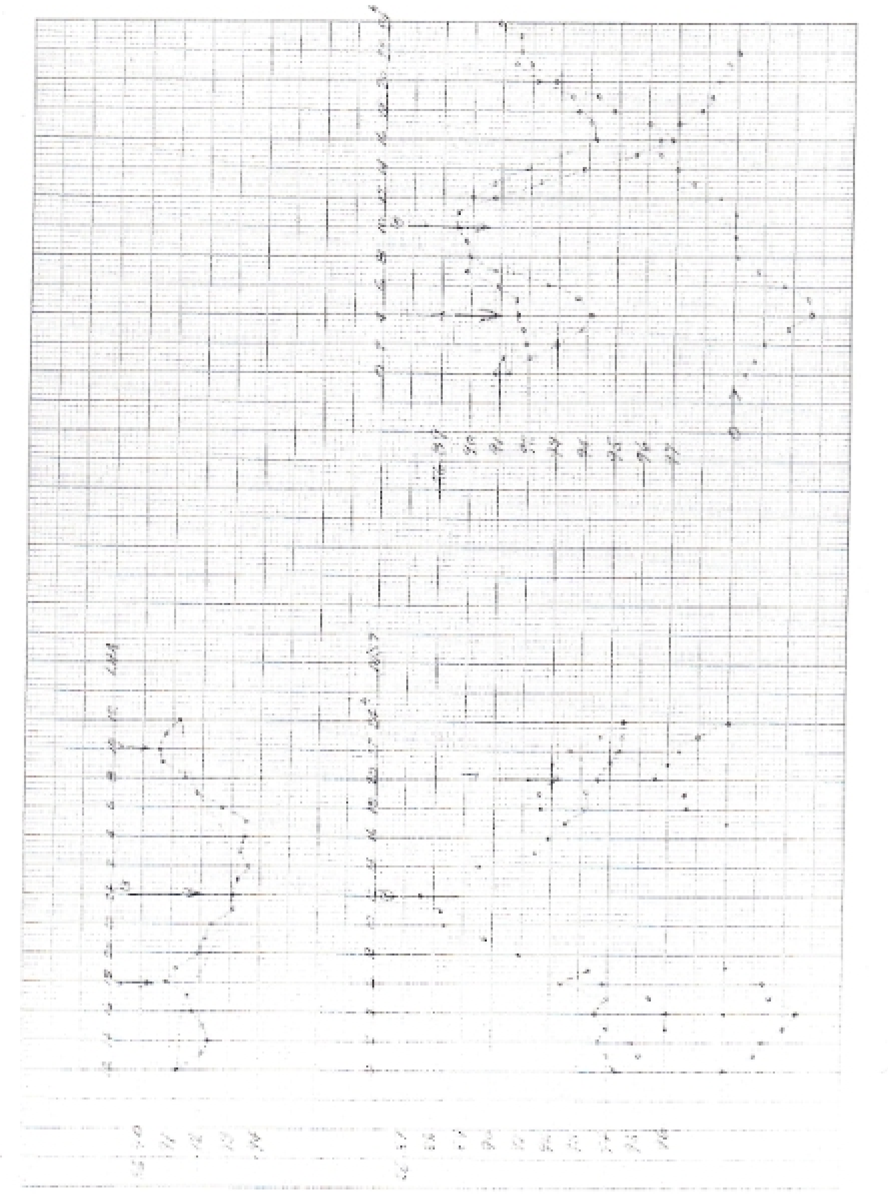
Misc. Data

Orbital speed of Earth 18.6 mps or 66,960 mph
Sidereal speed of Earth 12 mps or 43,200 mph

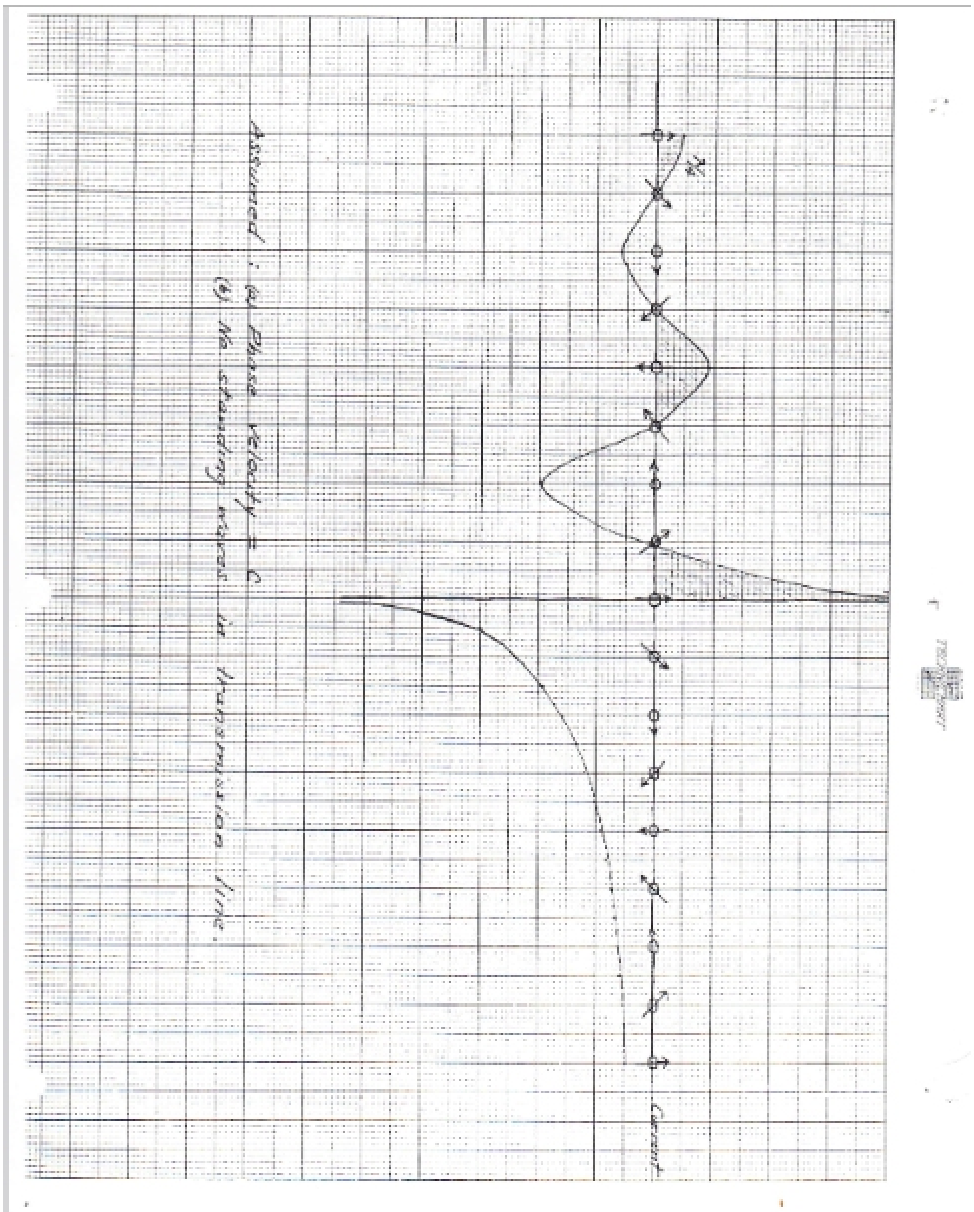
(87) []



(88) []



(89) []



(90) [31] [S1]

Part II
<u>Structure of Space</u>

It can be pointed out that the failure of the Michelson-Morley experiment to detect a flow of ether does not necessarily indicate the non-existence of the ether. The results of the theory of Relativity may be obtained <u>with</u> or <u>without</u> an ether.

For certain phenomena, it is desirable and almost necessary to assume the existence of an ether in order to evolve a satisfactory explanation. One example is the force of gravitation, particularly the electro-gravitational effects. The phenomenon of the movement of a dielectric is such an example.

The ether would, then, have many interesting and hitherto unsuspected properties, and it is the purpose of these notes to explore the subject qualitatively and to set forth some of the more important properties. Much of the work is based on facts derived from actual experiments which

cannot be satisfactorily explained without the existence of an ether possessing substantially these properties.

(91) [32] [S2]

Meaning of K and Mu

Electromagnetic theory assigns real values to K and mu of "free space". For the sake of simplicity the "ether" may be imagined to represent merely these "real values". It follows logically that space may not be uniform and that variations will occur in K and mu.

It is logical, also, to assume that space is "distorted" by the presence of matter and that this distortion actually may be a variation of K and mu. Finally, it is necessary to assign the direction or sense of the variation, and the clue is supplied by the behaviour of a light ray in passing a massive body.

Thus, the deflection of light is toward the massive body, and the effect is similar to or identical with <u>refraction</u>. It may be concluded that the values of K and mu near a massive body are <u>greater</u>. As a matter of fact the gravitational "field" may be visualized as an area or region of higher K and mu. The force of gravitation would then be the tendency to migrate to the higher K and mu

(92) [33] [S3]

Another interpretation is that the force of gravitation is a pressure from the areas of low Kmu to those of high Kmu. It follows that a low Kmu may be actually a region of high pressure in space, causing objects to move toward regions of lower pressure. This may be called "ether" pressure or space pressure, and may be assigned the terms high or low space potential as the case may be.

Perhaps, it is intuitively reasonable to assume that a maximum potential or entropy exists and that lower potentials are present as determined by the "presence" of massive bodies in space. We might consider the maximum potential of space that value where no mass is present, even at infinite distance. * It is not present actually, even in the space between the galaxies.

An interesting mechanical analogy is a lightly stretched rubber diaphragm without mass, the periphery of which is at infinity. Any mass would distort the sheet downward and by an amount inversely proportional to the square of the distance from the mass.

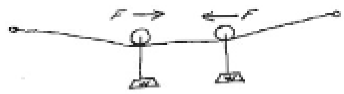
Fig. 1.

* Heavyside "Electromagnetic Theory", P 461

(93) [S 4]

Thus, two masses would be pressed toward one another.

Metal balls on rubber diaphragm.
FIG. 2.



Pulleys & weights on wire.
FIG. 3.

The maximum pressure of space can be determined from the energy "contained" in matter:

1 gram = 25,000,000 K.W.h

or

1.25 x 10^16 lbs./sq. in. *

Actually, it is difficult to imagine that the energy is contained in matter. More likely, it is the energy of space when referred to a complete void. For example, a glass globe (evacuated) submerged to its crushing depth in the deep sea, would suddenly disintegrate and send out a wave motion possessing energy. But, the energy was contained not in the evacuated globe but in the pressure of the water surrounding the globe.

It might appear that mankind lives in an ether "sea" of tremendous pressure, an ether "sea" likewise of unbelievable energy.

* Ross, New Views of Space, Matter & Time. P. 333

(94) [S 5]

Since unit positive and negative charges are the building blocks of all matter, it is worthwhile to speculate on the space-structure of the blocks themselves. In this, one is guided by relatively meagre evidence of an experimental nature. But perhaps a good start may be had by considering the mass effects of both, since it already appears that mass increases Kmu and reduces space energy.

Since the proton appears to possess the greater share of the mass of the atom, one would conclude that the positive "field" increases Kmu. For the sake of symmetry, the negative "field" decreases Kmu to the limit permitted by Kmu of "masslesss space". Conversely, the space energy of the electron field approaches that of space devoid of massive bodies, and outward (radial) pressures are maximum.

maximum.

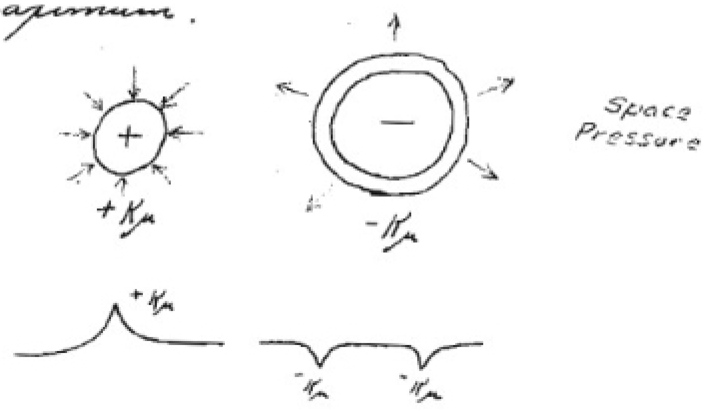


Fig. 4.

K mu not necessarily K x mu

(95) [S 6]

When the unit positive and negative charges are combined, as in the case of a neutron or atom, the increased Kmu of the positive is not completely neutralized by the decreased Kmu of the negative, tho the areas are equal and electrical neutrality results. A slight positive Kmu at the center of the system remains. Thus, a aggregate of these residual positive Kmu's produces the pure gravitational effects of neutral matter.

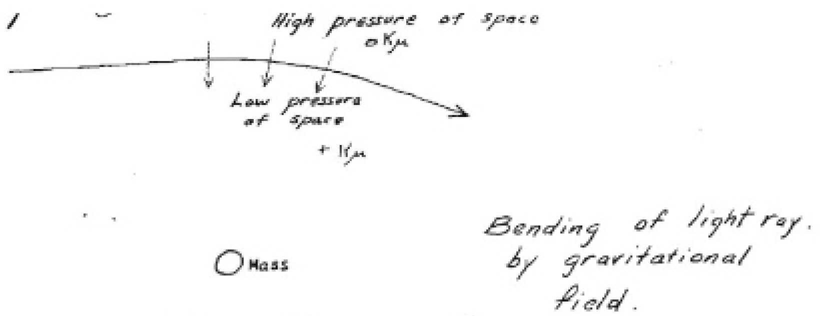
It is readily understandable that regions of positive Kmu's will be driven together by space energy, and it is fairly understandable that regions of negative Kmu's will be driven apart. Perhaps it would be better to say that normal intra-galactic space has positive Kmu, that regions more positive are driven together and that regions less positive are driven apart. These latter regions may be considered anti-gravitational and are driven out of the field in the same manner as a dielectric of low K is driven out of an electrostatic field with high K, or as a diamagnetic substance is driven out of a magnetic field with high mu.

For the sake of convenience, it is desirable to specify the minimum as that value present in extra-galactic space at an infinite distance from all matter

(96) [S 7]

This value will be negative with respect to the value of Kmu, as we know it in intra-galactic space, surrounded as we are by massive bodies. Assuming the accepted value of Kmu = unity, then Kmu minimum may be less than unity if proper units are selected. The potential energy is maximum when Kmu is less than unity. Any real value of Kmu indicates the presence of a lower potential of space, and a lower velocity of light.

A ray of light, therefore, will describe a path thru space as if it were bent by space pressures on the sides of the ray - as if the ray possessed mass. Increased Kmu and decreased velocity of light go hand in hand.



Bending of light ray. by gravitational field.

Fig. 5

In intra-galactic space electrons are driven apart. In extra-galactic space electrons do not exist as such. As an electron approaches extra-galactic space, the space energy or pressure gradient which makes it an

(97) [S 8]

entity ceases to exist. It is conceivable that as an electron gains velocity its Kmu becomes positive, approaching infinite mass, as the velocity approaches C.

Protons, or positrons, as the case may be, have a natural positive Kmu which increases as the field increases (toward the center of the positive charge). Space energy drives these particles together, but well known electrical forces drive them apart

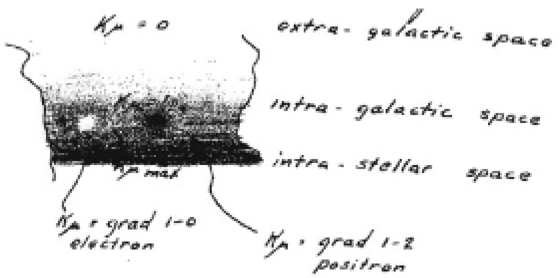


Fig. 6.

The energy situation is just the reverse

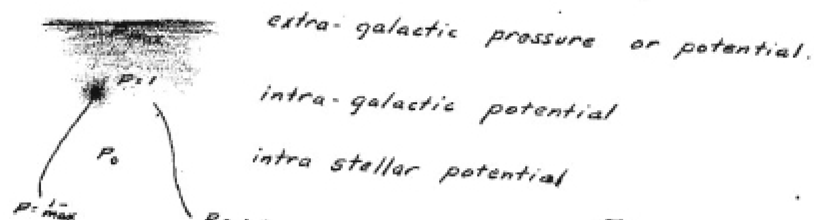


Fig. 7.

Positrons may not exist in the hearts of dense stars for the reason that the energy or pressure differential ceases to exist.

Electrons and positrons are complementary - one tending to increase and the other to decrease

(98) [S 9]

he space potential of the region wherein they exist.

The combination of an electron and a positron is electrically neutral but the slight positive value of Kmu remains to give the combination mass. In extra-galactic space the neutralizing effect of the electron is lost and the combination, if indeed it can exist, is a particle of great mass. Whereas, at the center of a star the effect is reversed and a value of Kmu is reached where mass no longer increases.

In other words, the mass of a particle increases as the space energy increases. This increase in mass is present where the velocity of light has increased due to lower Kmu. The two, therefore, are closely related.

<u>Electro-gravitational relation</u>

Considering the space potential of extra-galactic space, the field around a unit positive charge is the only "field" which is present. The direction of the force is toward the center of the charge, and the gradient increases toward the center. It is the "slope of the slope" which causes the difference in space potential toward the center of the charge. Whereas the electric field is merely the slope. "The gravitational field is the first derivative of the electric field."

(64) [S 10]

In intra-galactic space a negative charge produces a gravitational vector away from the charge. This is due to the fact that space energy and pressure is greater than that normal for the region. A combination of a positive charge and a negative charge arranged as a dipole produces a unidirectional gravitational vector from the negative to the positive pole.

If the positive charge is borne by an electrode of large mass (high density) and the negative charge by one of low density, the unidirectional vector is increased. For example, polarized Pb+O- along the line of motion.

Summarizing the above: a strong electric field affects the state of space energy. Regions of high space potential are to be found nearest the point negative charge and regions of low space potential nearest the point positive charge. The line of stress or force normally connects the two opposite charges. The quantity is a vector, depending upon the rate of change of slope of the electric field, directed away from the negative charge and toward the positive charge

$$\vec{F} = \frac{m_1 m_2 (\overleftarrow{E}_1 - \overleftarrow{E}_2)}{d^2}$$

(65) [S 11]

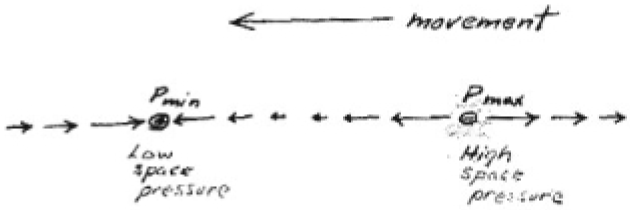


Fig. 8

Space pressure in vicinity of elec. dipole

Force depends upon the mass of the point electrodes and the mass of the region between the points. The exact function of mass is not clearly understood and an attempt will be made to develop the theory along these lines later.

In Fig. 8, true positive and negative charges are illustrated. They are what might be termed absolute charges. In practice, the potential of the Earth must be taken into account. The effects are significant.

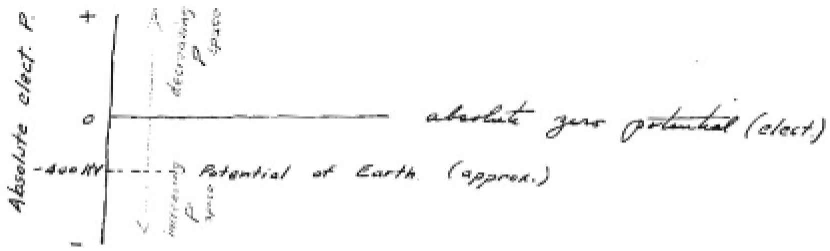
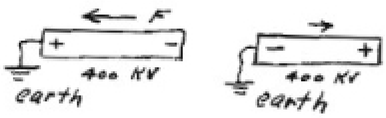


Fig. 9.

For example:



A non-linear electric gradient with steepest gradient near the negative will possess a greater space pressure differential and force than if polarity is reversed.

(66) [S 12]

If the steepest gradient is near the positive end when the electric (absolute) potential of the "positive" pole is actually negative, the direction of force will be toward the negative pole.

In the series of experiments conducted from 1925 to 1930, this anomalous behavior caused serious difficulty. No satisfactory explanation could be offered.

It will be observed in Fig. 8 that a pressure differential is produced by the electric dipole. The direction or sense of the pressure is, for the system as a whole, inward toward the positive pole and

outward from the negative pole. Reaction or recoil pressure which is exerted on the system mechanically is in the opposite direction, ie, from the negative to the positive pole.

Thus, it may be seen that a radiating dipole exerts pressures in the ether, first in one lateral direction, then in the other. The expanding wave of transverse pressure (electric) and transverse motions (magnetic) comprises the electromagnetic radiation.

(67) [S 13]

The gravitational field, therefore, is the "slope" of the electric field. The direction of the field is toward the positive charge or potential.

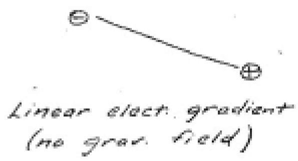


Fig. 10.

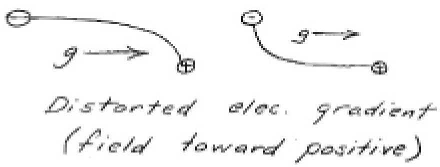


Fig. 11.

If, however, these point charges are not "absolute" electric potentials, as is usually the case in a "terrestrial laboratory", the following modifications are effective:

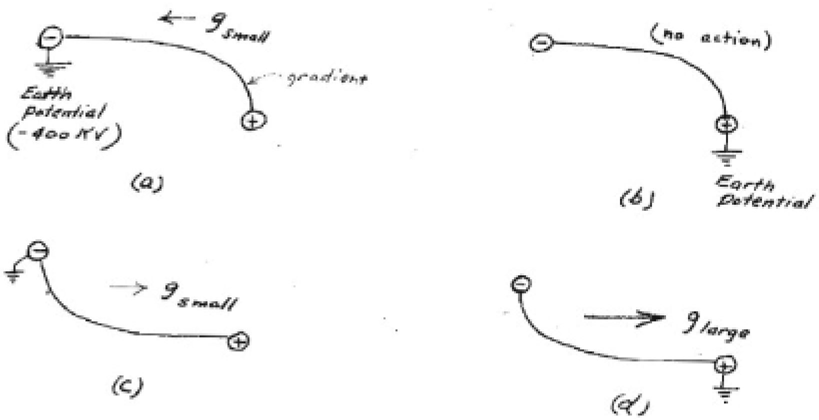


Fig. 12.

Since the intensity of the electric field, as well as the absolute potential, determines the effect in space, it is desirable that connection 12 (d) be utilized. Thus, the greatest gradient occurs

(68) [S 14]

near the pole having the greatest (absolute) negative charge. Kmu, consequently, is reduced to the lowest value for the voltage employed. The Kmu of the positive pole, while reduced below unity, is not reduced as far as that of the negative pole for two reasons: namely,

1. The gradient is not steep at that point.

2. The pole is not so far negative as the negative pole.

Compensation to the point of reversal of action is present in connection 12 (a). Here, the steep gradient is present around the positiev pole, causing great reduction of Kmu for that absolute potential (actually negative). The negative pole, on the other hand, has no nearby gradient and

consequently is not reducing Kmu as much as the positive pole. The result, of course, is a movement (or force) toward the negative pole, opposite to that called for in normal action.

Connection 12 (d) is therefore the optimum.

(69) [S 15]

These four connections are found to give forces qualitatively as indicated - by the series of experiments conducted from 1926 to 1930. See notebooks of these years.

Since the force developed by a differential in gravitational potentials (inversely Kmu) the force is always from the <u>high P to low P</u>, or, in other words, from <u>low Kmu to high Kmu</u>. Normally, this is from the negative to the positive pole - or from the <u>high gradient to the low gradient</u> in the case of one pole earthed.

Naturally, when the connection includes the Earth, the potential of the Earth affects the force developed (when applied voltage and other factors are held constant). As the potential of the Earth becomes more negative the force increases.

Since the action of the Philadelphia instrument is inverse, it follows that increase in scale readings indicates a more positive (less negative) earth. But this is subject to further check.

Therefore, predicated on confirmation by such a check, the principal characteristics of the diurnal variation are:

1. Sun-side of Earth negative.

2. "Windshield" side of Earth positive.

(70) [S 16]

Therefore, it is indicated that the solar gravitational field exhibited at the Earth induces a charge in the Earth.

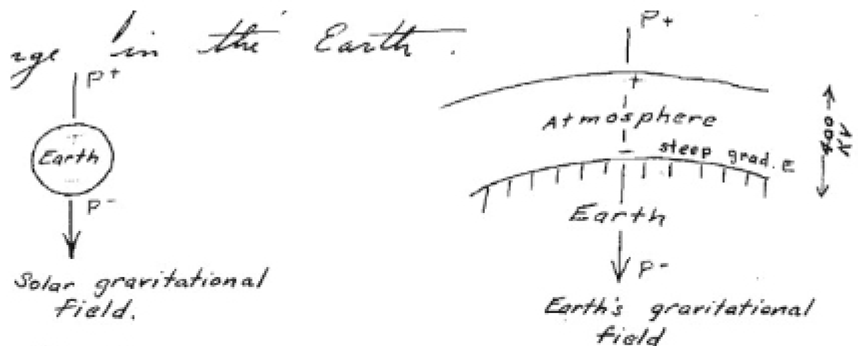


Fig. 13.

Fig. 14.

A similar field is induced (at least its presence can be so explained) by the gravitational field of the Earth. This field is present in the atmospheric envelope, making the Earth negative (approx 400 KV) with respect to outer reaches of the atmosphere. In a sense, this may be thought of as the electrical equivalent of "g". (100 Volts/meter at the earth's surface).

Acceleration (and probably velocity) causes a similar electric field, with the positive end always in the direction of the acceleration or velocity. Thus the positive charge on that side of the Earth "in front" as it moves both in the orbit around the sun and its motion toward 16" R.A.

Results of observations during 1937 and 1938 indicate a sidereal gravitational field toward a center approx 10" R.A. *

* Distance to galactic center approx 10,000 parsecs (32,500 light years) Orbital speed - 375 km/sec (620,000 m.p.h) P342 - Atomic Physics - Staff Univ. of Pittsburgh. John Wiley

(74) [S 17]

The electrogravitational equivalence revealed by the ele[ctric] potential of the atmosphere would indicate that an acceleration (or a gravitational field) induces a potential difference (electrical) and that the incorporated mass would tend to move.

If motion is permitted, the electric gradient decreases.

Thus if the atmosphere were permitted to "fall freely" in the Earth's gravitational field, its gradient would vanish. If accelerated upward against gravity, its gradient would increase.

Any block of dielectric in a gravitational field would behave similarly

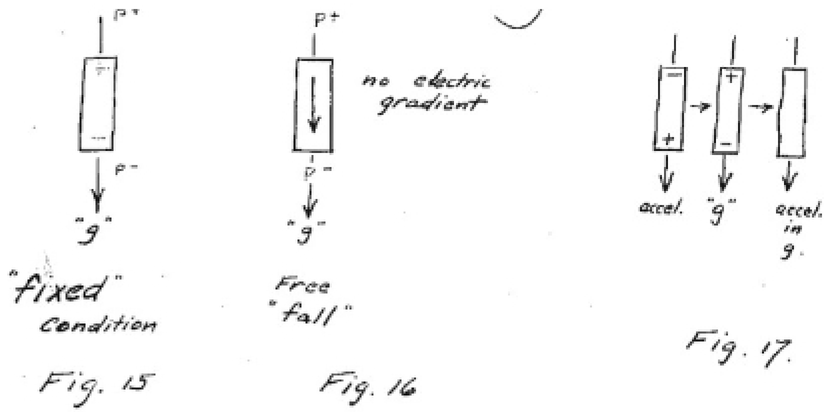


Fig. 15 indicates the electric condition of a fixed dielectric in a gravitational field "g". This charge arranges its polarity such that the positive is "up" and high gradient is "down", near the negative pole.

Acceleration produces practically the same electrical condition. Thus acceleration and gravitation are closely related.

(75) [S 18]

If, due to gravity, a dielectric body accelerates downward, its induced gradient is of such a magnitude and sign as to neutralize the gradient induced by the gravitational field. Fig. 17 shows how these potentials cancel.

Both gravity and acceleration induce <u>non-linear</u> electric fields in masses. The non-linearity of the field representing the magnitude of the gravitational field or the acceleration. Velocity induces a <u>linear</u> electric field, the potential difference being a measure of the velocity.

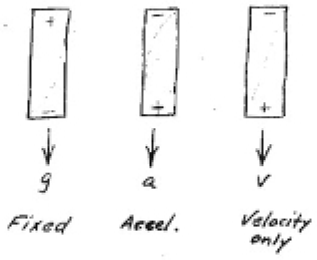


Fig. 18

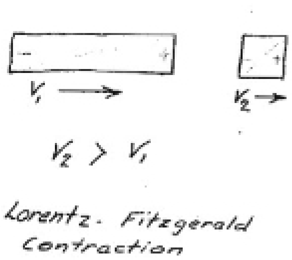


Fig. 19.

Fig. 19 sets forth an explanation of the contraction of physical objects along the line of motion by the increase of potential difference due to velocity.

Positive acceleration throws the steep gradient to the rear or negative end.

Negative acceleration throws the steep gradient to the front as well as the negative pole (as if the rear gradient possessed inertia).

(76) [S 19]

A modification of the explanation beginning on P.S 16 Fig. 14 appears to be necessary.

Actually the gradient of the atmosphere is steepest near the earth, i.e., at lowest elevations. Near the surface of the earth it reaches a value approx. 100 volts/meter. The arrangement of this gradient could well be due to the conductivity of the atmosphere and not a result of the gravitational or accelerational field.

By modifying this hypothesis so that the gravitational effect places the steep gradient away from the Earth, a more satisfactory explanation can be made.

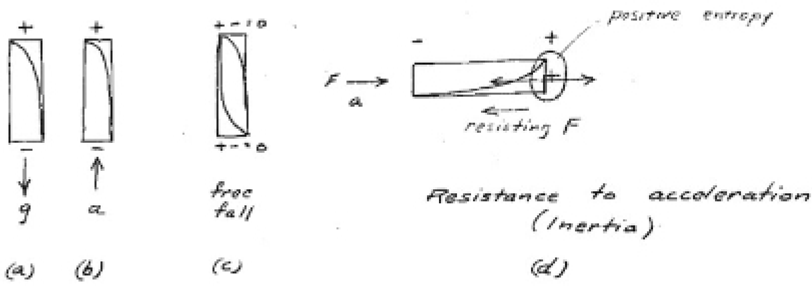


Fig. 19.

Thus, in Fig. 19 (d) the mechanical resistance (F) to acceleration is the electrogravitational F caused by the steepest gradient "in front". Negative acceleration is just the reverse. Force is produced because of the steepest gradient "in the rear"

(77) [S 20]

<u>The Effect of Dielectrics of Various K</u>

In the foregoing explanations the presence of a high electrostatic field (neg. average) in space tends to lower the value of Kmu below the ambient for the region. A dielectic of high K does not necessarily have a high Kmu (or low gravitational potential). Since the Q of the space is higher it may be argued that the presence of the field produces a greater elevation, not reduction, of the P of space.

Condition of max. F.

Fig. 20.

This is a preliminary assumption, subject to experimental check.

It is difficult to check, however, because the increase of mass is usually accompanied by an increase in K for any dielectric material. The force is a function of the mass caught in the gravitational potential difference, and therefore an increase in K would be actually a mass effect.

(71) Feb 1, 1943 [S 21]

<u>Tests of the Principle</u> No. 1

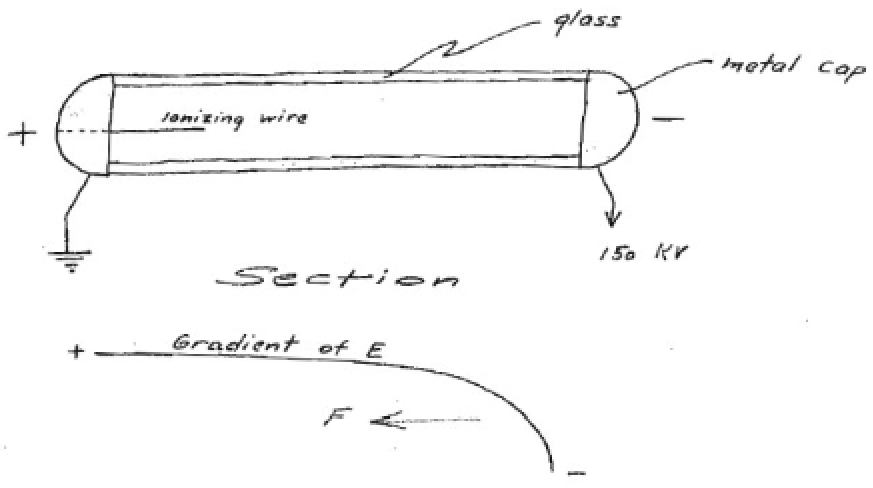


Fig. 21.

One of the simplest tests of the principle is shown in Fig. 21. It consists essentially of a glass tube (preferably heavy flint glass) approx. 4" diameter, 15" long, wall thickness about 1/4". Metal electrode caps are placed at the ends of the glass tube. A fine (.001") ionizing wire projects part way from one end (positive), attached to the electrode cap. A potential difference of 150 KV is applied. The positive is grounded.

A non-linear gradient is formed. Positive space energy is "created" at the negative end, resulting in force or movement of entire system toward the positive end. The force will be a function of the mass of the glass tube.

(72) [S 22]

<u>Tests of the Principle</u> No. 2

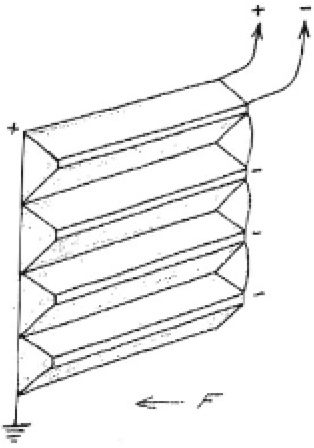


Fig. 22

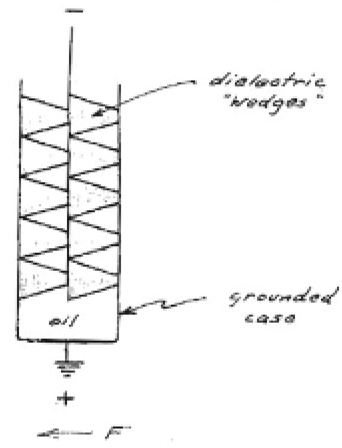


Fig. 23.

In order to obtain the desired non-linear electric gradient in the dielectric material, the wedge-shaped design is suggested. This eliminates the necessity for the ionizer shown in Fig. 21.

When oil is used, as in Fig. 23, care must be exercised to keep its resistivity high in comparison to that of the dielectric "wedges". Electro-gravitational forces are in the direction as indicated

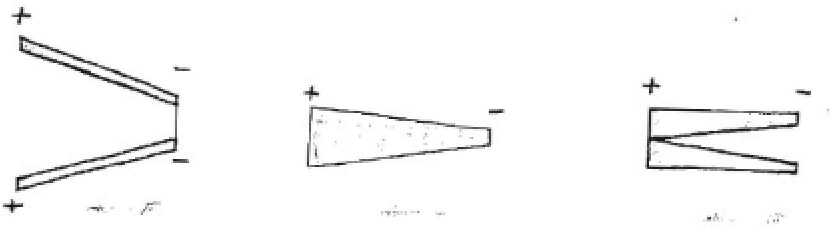


Fig. 23(a) Fig. 23(b) Fig. 23(c)

Types of dielectric wedges (sections of cones)

(73) [S 23]

<u>Tests of the Principle</u> No. 3

Fig. 24.

If effects of a differential in mu are similar to those of K, the system illustrated above may produce the indicated force. No actual experimental evidence, however, is at hand. Such a system, if found operative, may constitute the relation (magneto-gravitational) which has been expected.

A dynamical system would include a radiating dipole located near the coil on the permalloy rod. Radiation would be impeded in the direction of the higher mu, the lobe projecting principally in the direction opposite.

(40) [S 24]

Tests of the Principle No. 4

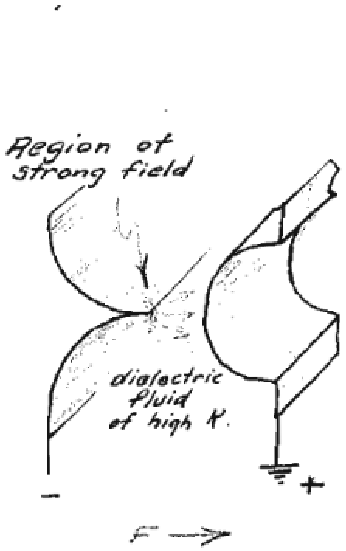


Fig. 25 (a)

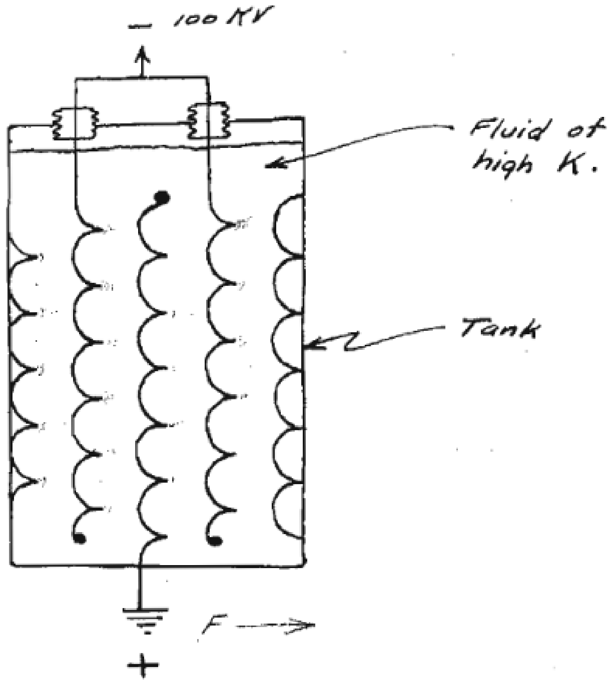


Fig. 25 (b).

Utilizing the strong electrostatic field of a point, the non-linear gradient to a spherical surface, within a dielectric fluid of high K, offers favorable conditions for the generation of the electro-gravitational force. The outstanding advantage is that a rupture of the dielectric, due to excessive gradient, is self-repairing. The space immediately adjacent to the point possesses the greatest "space potential" and the fluid is present throughout the gradient. Forces are produced in the indicated direction, not merely forces due to point discharge but to electro-gravitational gradients. Fig. 25 (b) shows a fully-enclosed system. The forces are developed in the fluid and transmitted to the walls of the tank.

(41) [S 25]

Tests of the Principle No 5.

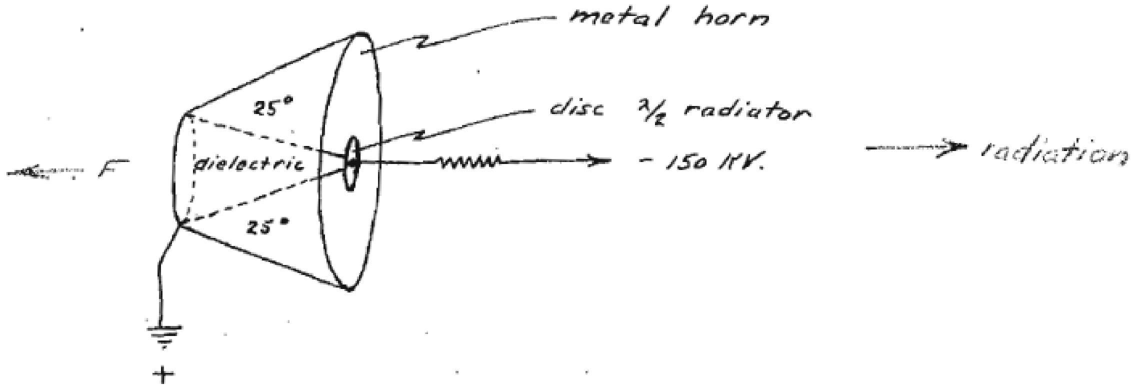


Fig. 26.

This is a dynamical system, parallel to that described in Par. 2 of P. S 23, and is similar in many respects to that shown on P. 75. It features a lambda/2 disc radiator at the high negative terminal. The radiation is impeded by increasing values of K as it travels along the dielectric, but leaves unimpeded outward from the horn as indicated. The electrogravitational force is in the same direction as the radiation pressure.

It may be found desirable to provide a means for heating the lambda/2 disc radiator in order to increase electron emission.

(42) [S 26]

<u>Tests of the Principle </u>No 6.

Test of the Principle. No 6.

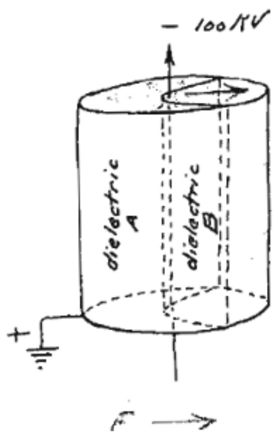


Fig. 27

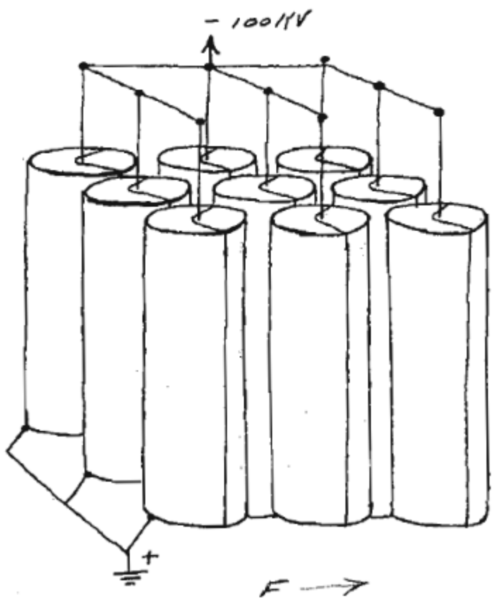


Fig. 28.

This is a "potential" system (as differentiated from a "dynamical" system). It employs a wire electrode (negative) at high potential, concentrically arranged in a cylinder which constitutes the

positive electrode (grounded). A small sector of dielectric material B has greater K and mass than dielectric sector A. Since space energy is greatly increased by the steep electric gradient around the wire, gravitational forces are outward from the negative electrode. A mass (and K) differential exists, however, which causes the resultant F in the direction as indicated.

Fig. 28 shows the parallel connection of a multiplicity of "cells".

Feb 1 1943 - T T Brown

(43) [S 27]

The electro-gravitational equilibrium

In summarizing, it is indicated that electrons, being essentially areas of high space energy cannot exist as entities where space energy is already maximum. In other words, in theoretical mass-free space (extra-galactic), electrons do not possess the gradient which makes their existence possible. See P. S6 & S7. Positrons, on the other hand, can exist due to the great contrast in potential, the gradient in space energy being reversed.

So it can be interpreted that pure space energy is essentially equivalent to electricity and that extra-galactic space is negatively charged. Any gravitational field will possess an electric field, the direction of which is from negative to positive. In this way, gravitational or space potential is inversely related to electrical potential. A fully insulated body assumes an electric charge which is related to the gravitational potential of the space in which it exists.

As an example, in the solar system the electric potential of the planets is of negative origin and that of the sun is positive. The more distant planets are the more negative.

(44) [S 28]

In a sense, one may imagine the gravitational potential as inversely related to electric potential.

If the sun is considered the seat of the gravitational disturbance in the solar system, the value of P or E at the center of the sun is the minimum for the system.

Consequently, the positive charge is maximum for this region. It has been estimated, as a matter of fact, that the potential of the sun is of the order of a billion volts positive, * with respect to the earth. Other investigators * have indicated the potential of the Earth at 400 KV negative with respect to the highly ionized layers.

By the same token one may predict the electric potential of Venus to be positive with respect to the Earth and that of Mars negative. Both, however, are negative with respect to the sun or positive with respect to Jupiter or Saturn.

It is probable that the potential difference between the sun and its planets increases more slowly as the distance from the sun increases; as

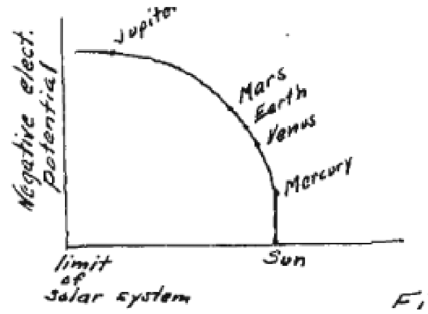


Fig. 29.

Electrical Potential of the Planets due to Gravitational Field of the Sun.

* Heaviside "Electromagnetic Theory"

* [illegible]

(45) [S 29]

By the same reasoning, the potential of the moon is negative with respect to the earth, due to its inclusion in the dominating field (gravitational) of the earth.

Perhaps then, this causes the side of the earth directed toward the moon to become positively charged by induction. This may explain the positive swing of the Philadelphia instrument as the moon crosses the meridian.

If the sun is highly positive, the side of the earth toward the sun will acquire an induced negative charge. This also appears to be borne out in the results of the Philadelphia observations.

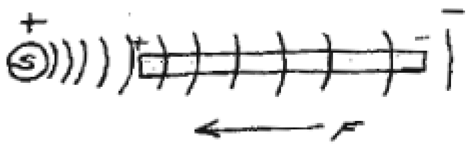


Fig 30.

When a system of masses comprising a dielectric, exists in a gravitational field, the end toward the "attracting" mass will become positively charged with respect to the other end. Likewise, a steeper gradient will be present at the positive end. A gravitational force F is present which depends upon the gradient differential. If the dielectric accelerates in response to this force the gradient differential disappears as the acceleration approaches that of g.

(46) [S 30]

The disappearance of the induced gradient differential is due to the appearance of an opposing gradient differential due to acceleration. This is the equivalence of the gravitational field and the acceleration "field".

A freely falling body therefore has no gradient differential. It does, however, have an increasing potential differential (elec.) which increases as the velocity increases. P. S19.

Fig. 31.

Centrifugal force is the electrogravitational force due to acceleration. It is equivalent to a gravitational force and is indistinguishable from it. An equilibrium orbit is one in which both forces are equal and opposite.

Centrifugal force not opposed by an equal gravitational force should produce gradient differentials.

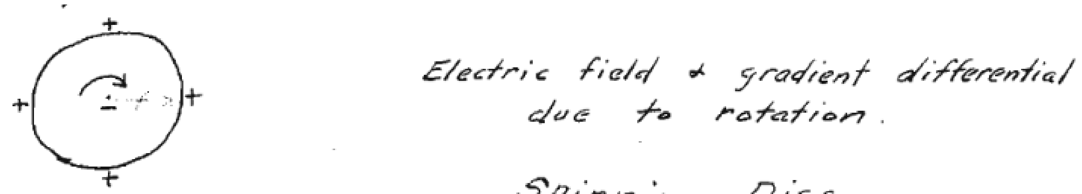


Fig. 32.

(47) Feb 15, 1943 [S 31]

Centrifugal (electrogravitational) generator.

Based on the foregoing, it appears that a generator can be constructed along the following lines:

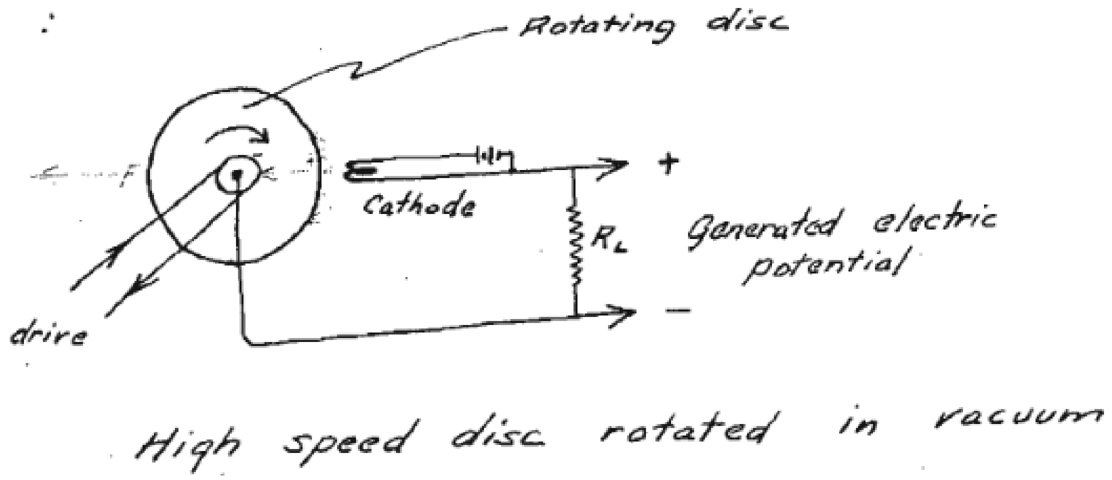


Fig. 33.

When the metallic discs (and in certain cases, dielectric materials) are rotated at high speed, the periphery becomes positively charged and the axis of rotation negative. If a cathode (heated) is

placed nearby electrons are drawn out and attached to the disc. As a result a current flows and a potential difference generated across a load as indicated.

When current flows, the steep gradient is (to a slight effect) shifted from the periphery (see P. S30) to the axle, thereby neutralizing some force (centrifugal) at that region. The force indicated by the F (in green) is due to the resultant imbalance. The magnitude of this force is directly proportional to the current which is flowing in the system. If this current is increased by an external battery the force is further increased.

(48) [S 32]

The effect of rotation is equivalent to the "throwing outward" of the heavier charges which are positive. The "anti-gravitational" electrons are thus displaced to the center. The high gradient is likewise thrown outward as if the electric field itself possessed inertia. Since rotation is equivalent to the effects of gravitation, the "g" of the centrifugal "field" is productive of electrical gradient:

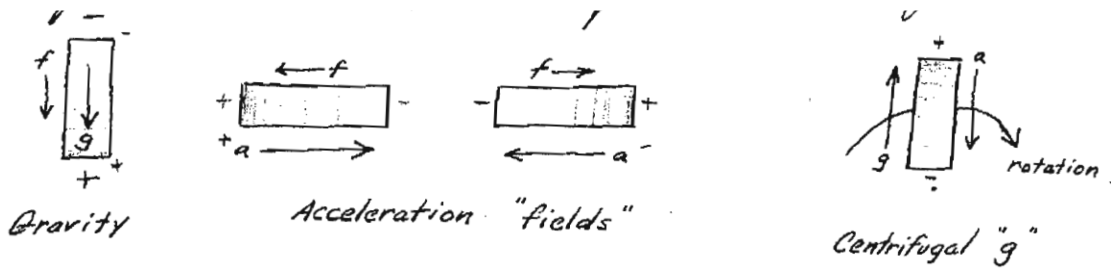


Fig. 34.

It is desirable to call attention to the necessity for the emitting cathode of Fig. 33 to be extended over a considerable arc of the disc in order that the gradient may not be steep at the region where electrons strike the disc. For successful operation the induced gradient must be steep at the axle, in the direction of the cathode.

It is possible also that dielectric discs, made for example from high tensile strength Bakelite, may produce results even with no appreciable current flowing. In this way, the system may be considered "potential" (P. S-26). Strong gradients would be "maintained" against leakage only.

(49) Feb 22, 1943 [S 33]

Feb 22, 1943

Tests of the Principle. No. 7

In order to increase gradient differentials and at the same time reduce the space and voltage requirements, the following structure is suggested:

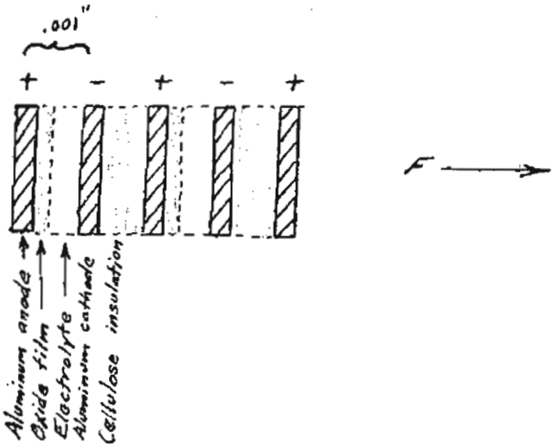


Fig. 35

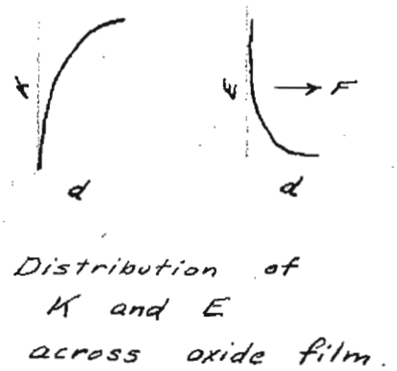


Fig. 36.

Due to the change of K with d, across the oxide film, the electric gradient is greatest near the anode and falls off to a negligible value at the surface of the electrolyte which forms the central cathode. Electrogravitational force is in the direction away from the steep gradient (as indicated).

What little gradient differential exists in the cellulose insulation is in the region immediately adjacent to (and caused by) the cathode. The electrogravitational force is therefore in the same direction as that in the oxide film.

The system would utilize comparatively low voltages (500 V maximum) but the gradient differential might reach exceedingly high values.

(50) Feb 22, 1943 [S 34]

Tests of the Principle. No. 8

On the basis of an effect due to gradient in K, see P. S 20, the following structure is suggested:

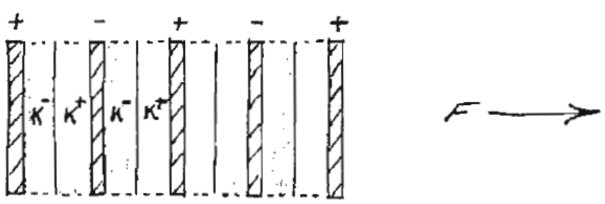


Fig. 37.

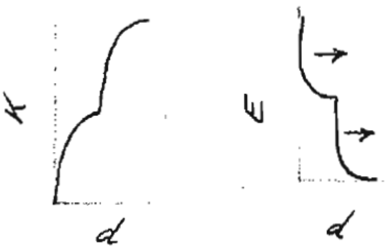


Fig. 38.

Due to the high value of K in one dielectric section and the low value in the adjacent section, the voltage gradient is greatest near the left boundary of the "red" section and falls to a minimum at the right boundary of the "green" section. Electrogravitational force is as indicated. Direction of the force is not changed by reversal of polarity in adjacent units.

The above effect, as well as that set forth in P. S-33, has not been tested. Success of the method is predicated on the assumption that the gradient differential alone, and not the combination of E and K gradient, determines the force.

This latter possibility is worthy of consideration and therefore will be discussed in succeeding pages.

(51) Feb 23, 1943 [S 35]

Electric gradient differential versus "space potential" gradient differential.

There is an important difference between the two. For instance, where the value of K is physically constant throughout the dielectric, forces result directly from an electric gradient differential. If K varies, the electric gradient varies inversely. The distribution of electric charge (Q) remains the same however. Actually, it would appear that the change Q per unit volume in space determines the “potential” of space. Therefore, what may actually be desired to produce an electrogravitational force is a gradient differential in “space potential” or the “quantity” of change in space. By this reasoning, test No. 8, (and probably No. 7 also) might be expected to fail.

If a dielectric block has a physical gradient in K, the electric field will be found to arrange itself so that there will be an inverse gradient in E, this being so in order that the quantity of charge Q might be evenly distributed. It would be expected therefore that no gradient in Q exists, and no electrogravitational forces would be present.

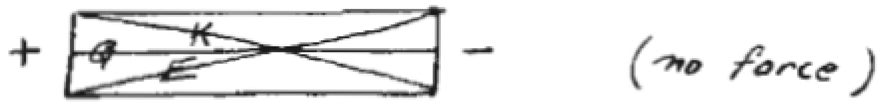


Fig. 39.

(52) [S 36?]

If, however, a condition should be set up where a gradient differential exists in Q, electrogravitational forces are present which attempt to “correct” the condition. The correction is in the form of applied velocity, or in the first stages, acceleration.

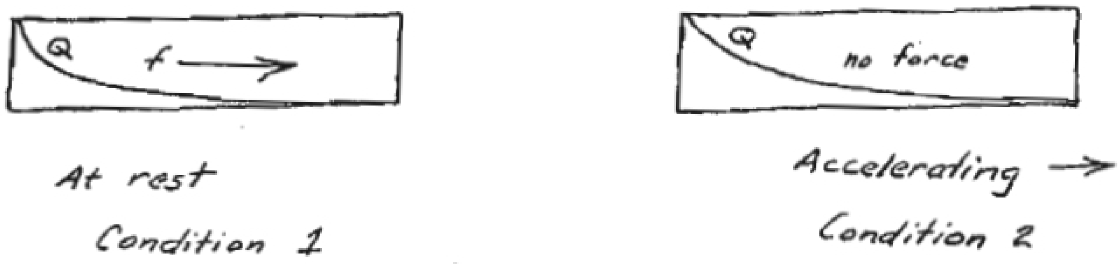


Fig. 40.

Maximum force may be developed by a system possessing both a gradient in K and a gradient in E, thus a maximum gradient differential in Q.

The gradient in E can be obtained by the wedge shape, (P. S-22), and the force is always in the direction away from the high gradient when the system is near the potential of the Earth. In other words, it is toward the large end of the dielectric.

If, at the same time, the wedge would have a non-linear gradient in K, such that the greatest change in gradient is near the small end, the force would be still further increased. Thus:

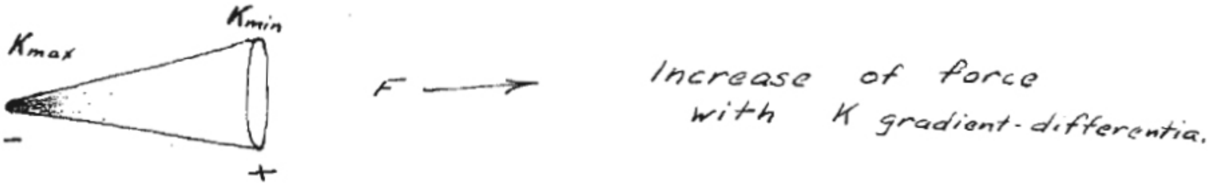


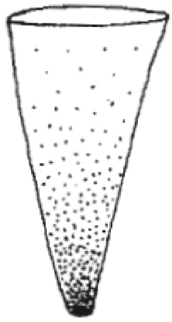
Fig. 41

(53) [S 37?]

A gradient in K tends to straighten the gradient of potential (electric) in the case shown in Fig. 41. A very steep gradient in K would even reverse the electric gradient differential. It is conceivable that this would operate to a practical advantage. For instance, where the electric gradient near the cathode is so steep that breakdown would normally result, a high value of K in the region would so shift the field as to reduce the electric strain. Thus the electric field might be made uniform, with a strictly linear gradient, and yet the required gradient differential in space potential would be maintained, and an electrogravitational force would still be present.

Thus, it is possible, and apparently quite advantageous, to have the electric gradient uniform in a wedge dielectric section. Such a construction would prevent excessively high electric fields from forming across the region of restricted cross-section.

Experimental cones of graduated K.



Mould filled with mixture of PbO and paraffin.

PbO allowed to settle as cooling progresses

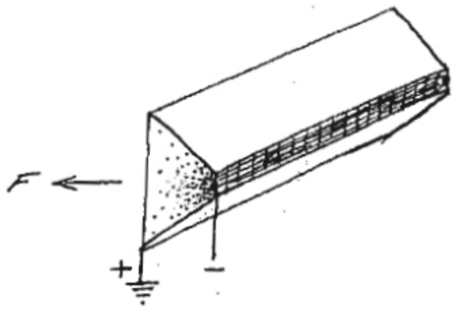
To be connected as shown in Fig. 41.

Fig. 42.

(54) Mar 1, 1943 [S 38]

Tests of the Principle No. 9

Cones of graduated K, as described on P S-37, can also be formed into arrays. The dielectric wedges described on P. S-22 can also have graduated K, and then formed into arrays. The results apparently will be more satisfactory.



Wedge of dielectric with graduated K.

Fig. 43.

Due to the equilibrium between the gradient of K and the gradient of E, it appears that the principal advantage of a gradient in K are:

(1) to prevent excessive fields in the region of restricted cross-section

(2) to permit a greater force due to the presence of regions of high Q

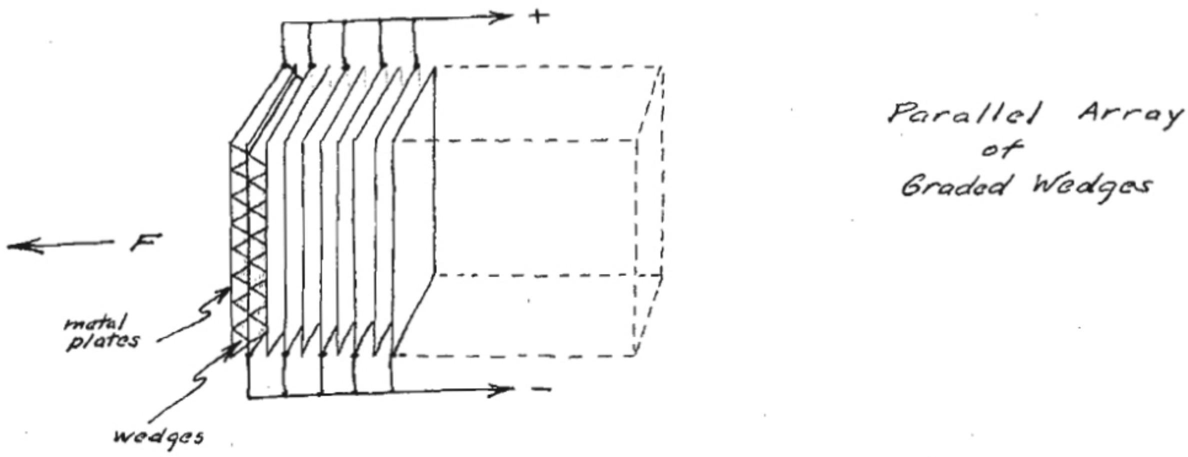
A multiple array of graded wedges is a development of that shown in Fig. 43.

Even without a gradient in K, such an array, when operated at low voltage, appears to have considerable promise.

(55) Mar 3, 1943 [S 39?]

Test of the Principle No. 10

Pursuant to the development indicated in Test No. 9, the following type of construction appears worthy of consideration:



For a unit to operate on 5 KV, the spacing between successive electrodes could be on the order of ¼ " . Dielectric wedges would be made of PbO with a binder, so prepared as to give a K gradient. Tests of dielectric material of naturally high K, such as slate or marble, and without a K gradient, could be made for the purpose of determining the actual practical value of a K gradient. In general it appears that the force will be a direct function of the dielectric K, and independent of the K gradient. The only effect of the K gradient being to redistribute the electric field so as to cause less strain and less possibility of progressive electric breakdown.

(signature) T T Brown

Witnessed as to date:

Ralph H Swift 3/3/43

William F Mangham 3/3/43

(56) Mar 3, 1943 [S 40]

Excitation Potential – AC vs DC

Naturally, direct current, due to the sustained charge, gives best results:

(1) Maximum continuous force

(2) Minimum loss in the dielectric by hysteresis, etc

However, alternating current excitation may be desirable in order to reduce the amount of exciter equipment and the total weight. It is to be borne in mind that the direction or sense of the electrogravitational force is not reversed by a reversal of the electric field. The force depends primarily on the differential in the electric gradient.

Transformers with Benetron rectifiers with suitable filters are required for DC excitation.

For AC excitation, a transformer may be used without additional equipment. For increased efficiency, the inductance of the transformer secondary should be matched to the capacitance of the dielectric system (gravitator) for the particular frequency used, thus creating a tuned circuit.

(57) May 2, 1944 [S 41?]

Brownian Movement

The basic considerations, set forth in Fig. 8, P S-11, indicate a continuous force or motion of a dipole, always toward the positive pole if there is any absorbing matter in the space between. It is conceivable that some force or motion might be present if no absorbing matter lies between, due to the pressure differential at the sides (in the alignment of) the dipole.

The suggestion appears reasonable that molecular motion is the result of this pressure differential. Movement of any single molecule would invariably be from its negative elements to its positive elements; the movement of all molecules would appear random.

If a means could be found to align or polarize all molecules in a given volume of matter, it is conceivable that motion of the volume, as a whole, would result.

Probably a considerable amount of polarization or alignment can be accomplished by an electrostatic field, or momentarily by a varying magnetic field.

(58) [S 42?]

Another method of approach might be the mechanical. It is possible that supersonic waves might align molecules, much as sawdust is arranged in a Kundt's tube.

Certain forms of solid matter may be found more easily polarized and may even be partly polarized in natural form – for example, quartz crystal, other piezo-electric crystals, alnico or other magnetic material of high retentiveness.

Other lines of investigation might include the use of "electrets", electrically polarized bodies, such as certain waxes, which have hardened in an electric field.

(59) [S 43]

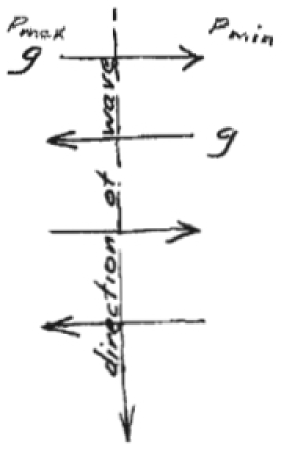
Space Pressure equivalent to Gravitation

On P. S-11, the space pressure effects of the electric dipole were illustrated. It was shown that the oscillating dipole radiated electromagnetic waves laterally. Space pressure first in one lateral direction, then in the other, travels as a wave. Wherever it strikes a conductor, its electrical effects become manifest. However, the alternating electric potentials actually exist in the space the wave traverses. The wave actually changes the electrical condition of "empty space" as it travels along. A conductor, existing in that space, merely picks up the changing potential of the ambient space.

Space pressure differential is indistinguishable from gravitation. Its direction from high pressure to low pressure is the direction of gravitational "force". One might say that to "look" at an approaching light (or other electro-

(60) [S 44?]

magnetic wave) one would "see" merely a gravitational field operating transversely to the direction of the wave, first to one side then to the other.



The light wave as transverse alternations of a gravitational field.

Fig. 45

The "passing by" of this alternating gravitational field induces an alternating current of electricity in any conductor arranged in in the alignment of the field, at right angles to the direction of the wave.

If a sufficiently sensitive tuned reed could be placed in the path of the wave, it is possible it would be set in oscillation or vibration mechanically, in the lateral direction by the transverse gravitational wave.

If the wave travels transversely from the radiating dipole, that is, to the side

(61) [S 45?]

of the dipole, then by the same token, it must travel away from the ends of the dipole. However, it would not be transverse and would not be "picked up" by a transverse "device". Rather, it would be pulsating gravitation, with pulsing forces to and fro, in the direction of the alignment of the dipoles.

Fig. 46. Pulsing Gravitation.

Electric potentials of various gravitational potentials

Referring to Fig. 7, P. S-8, in extra galactic space the pressure or potential is maximum. Also the electrical potential is maximum negative. In such space an electron (neg.) cannot exist as an entity, for the reason that the "differences" between the neg. electron and the space surrounding it "do not exist" where no gravitational fields are present, ie, in extra galactic space. The electron is "equivalent" to the space surrounding it. In fact, in the last analysis, the electron merely "melts into" and becomes indistinguishable from that space. One could say that this space

(62) [S 46?]

is negative and "of the same composition" as the negative electron. Perhaps one could call such space "a completely negatively charged continuum".

As one approaches a material body the quality of space undergoes a change. The space pressure becomes less. The pressure difference causes a gravitational "field" toward the material body. Since the space occupied by said body has a lower pressure or potential, it also as a more positive electrical potential. See P. S-28. Consequently, the body itself shares this ambient electrical condition.

Conceivably, at the center of dense stars in the center of a galaxy, the space pressure is a minimum, approaching if not reaching, zero. Here, the absolute electric charge is maximum positive. A positron, as a separate entity, would not exist, for the reason that it would be of the same composition as the "space" surrounding it. Under such conditions of density (at the heart of dense stars) it is even probable that no "space" does exist, and that a positron, as a "hole" in space, cannot exist where there is no space. This then, would be the positive electrical continuum, more than likely just plain zero.

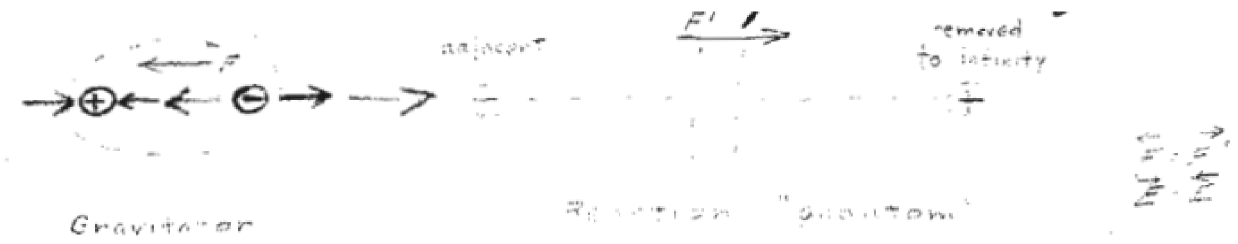
(63) [S 47?]

By such reasoning, only one "kind" of electricity actually exists – the negative. Electrons being "knots" of high "space pressure", while positrons are merely "inverse knots" or holes in space where the pressure approaches zero, "like the center of a cyclone".

The Gravitator

An electric dipole is a gravitator. It gravitates just as surely as a falling body. It possesses a force (from negative to positive) due to a dissymmetry of space pressure. The reaction to the force is in the opposite direction and is in the form of a gravitational field, "blowing backward from the rear". This field extends indefinitely "backward". It reacts against material bodies near and far. The integrated reaction forces, on all objects to the limits of the universe, equal the force of the gravitator in the "forward" direction.

These reactive fields or space pressures (space potential differences) cause electrical potential differences which are exactly equal and opposite to the electrical potentials of the dipole.



[End of Structure of Space, and of the Vega document as found in the scanned PDF]